Ontario Geological Survey
Aggregate Resources Inventory Paper 89

AGGREGATE RESOURCES INVENTORY OF THE CENTRAL PART OF THE CITY OF TIMMINS

Cochrane District

NORTHERN ONTARIO

by
Staff of the Engineering and Terrain Geology Section
Ontario Geological Survey

1983

THIS PROJECT WAS FUNDED BY THE ONTARIO MINISTRY OF NORTHERN AFFAIRS THROUGH THE REGIONAL PRIORITY PROGRAM

Ministry of Natural Resources

Hon. Alan W. Pope
Minister

W. T. Foster
Deputy Minister

Ministry of Northern Affairs

Hon. Leo Bernier
Minister

David Hobbs
Deputy Minister

© OMNR-OGS 1983

Publications of the Ontario Ministry of Natural Resources
and price list
are obtainable through the
Ontario Ministry of Natural Resources, Map Unit, Public Service Centre
Queen's Park, Toronto, Ontario
and
The Ontario Government Bookstore
880 Bay Street, Toronto, Ontario

Orders for publications should be accompanied by cheque
or money order, payable to the Treasurer of Ontario

ISSN 0708-2061
ISBN 0-7743-7285-0

This report was prepared by: Staff of the Aggregate Assessment Office, Engineering and Terrain Geology Section of the Ontario Geological Survey, Ontario Ministry of Natural Resources, 77 Grenville Street, Toronto, M5S 1B3, Telephone (416) 965-1182.

Project Supervisor: Dale W. Scott
Text Prepared by: G. Jones
Compilation and Drafting by: Staff of the Aggregate Assessment Office

The Lands and Mineral Resources Staff of Timmins District and The Timmins Regional Sub-Office of the Ministry of Natural Resources assisted in the collection of data, field checking and review of this report.

Parts of this publication may be quoted if credit is given to the Ontario Ministry of Natural Resources, Ontario Geological Survey. It is recommended that reference to this report be made in the following form:

Ontario Geological Survey
1983: Aggregate Resources Inventory of the Central Part of the City of Timmins, Cochrane District; Ontario Geological Survey, Aggregate Resources Inventory Paper 89, 49 p., 8 tables, 3 maps, scale 1:50 000.

Every possible effort is made to ensure the accuracy of the information contained in this report, but the Ministry of Natural Resources does not assume any liability for errors that may occur. Source references are included in the report and users may wish to verify critical information.

500-83-IMC

CONTENTS

	Page
Abstract	v
Introduction	1
Part I - Inventory Methods	2
Field and Office Methods	2
Resource Tonnage Calculation Techniques	2
Sand and Gravel Resources	2
Bedrock Resources	3
Units and Definitions	3
Part II - Data Presentation and Interpretation	4
Map 1 Distribution of Sand and Gravel Deposits	4
Deposit Symbol	4
Texture Symbol	4
Map 2 Selected Sand and Gravel Resource Areas	5
Site Specific Criteria	5
Deposit Size	5
Aggregate Quality	5
Location and Setting	6
Regional Considerations	6
Map 3 Bedrock Resources	7
Selection Criteria	7
Selected Resource Areas	7
Part III - Assessment of Aggregate Resources in the Central Part of the City of Timmins	9
Location and Population	9
Physiography and Surficial Geology	9
Extractive Activity	10
Selected Sand and Gravel Resource Areas	10
Selected Sand and Gravel Resource Area 1	11
Selected Sand and Gravel Resource Area 2	11
Selected Sand and Gravel Resource Area 3	12
Selected Sand and Gravel Resource Area 4	12
Selected Sand and Gravel Resource Area 5	12
Sand and Gravel Resource Areas of Secondary Significance	12
Bedrock Geology	15
Selected Bedrock Resource Area 1	16
Summary	16
References	41
Appendix A - Suggested Additional Reading	43
Appendix B - Glossary	44
Appendix C - Geology of Sand and Gravel Deposits	47
Appendix D - Geology of Bedrock Deposits	49

TABLES

1 - Total Sand and Gravel Resources, Central Part of the City of Timmins	17
2 - Sand and Gravel Pits, Central Part of the City of Timmins	19
3 - Selected Sand and Gravel Resource Areas, Central Part of the City of Timmins	24
4 - Total Identified Bedrock Resources, Central Part of the City of Timmins	25
5 - Quarries, Central Part of the City of Timmins	27
6 - Selected Bedrock Resource Areas, Central Part of the City of Timmins	28
7 - Summary of Test Hole Data, Central Part of the City of Timmins	29
8 - Described Sections, Central Part of the City of Timmins	35

FIGURES

1 - Key Map Showing Location of the Central Part of the City of Timmins	v
2 - Aggregate Grading Curves, Central Part of the City of Timmins	37
3 - Aggregate Grading Curves, Central Part of the City of Timmins	39

MAPS
(back pocket)

1 - Distribution of Sand and Gravel Deposits, Central Part of the City of Timmins, Scale 1:50 000.
2 - Selected Sand and Gravel Resource Areas, Central Part of the City of Timmins, Scale 1:50 000.
3 - Bedrock Resources, Central Part of the City of Timmins, Scale 1:50 000.

ABSTRACT

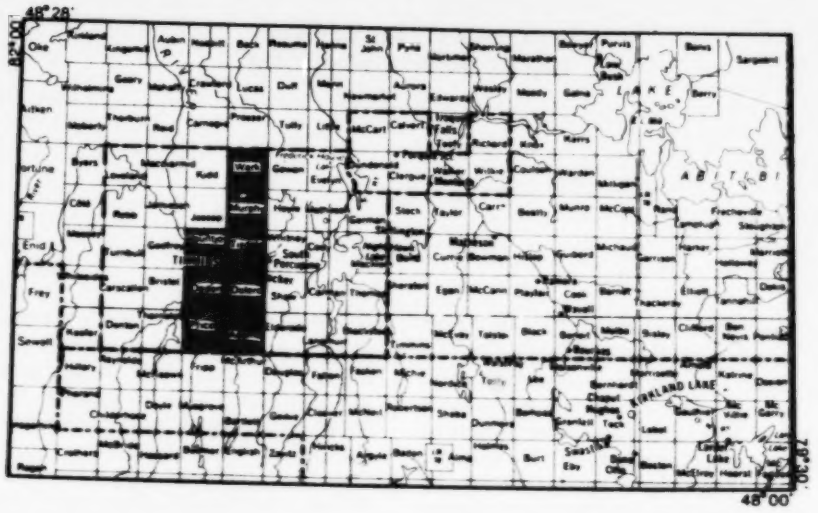


Figure 1 - Key Map Showing Location of the Central Part of the City of Timmins, Scale 1: 1 800 000.

This report includes an inventory and evaluation of sand and gravel as well as bedrock resources for seven townships located in the central part of the City of Timmins. The report is based on previous studies in the area and a detailed field assessment undertaken in the summer of 1981 by a two-man field party funded by the Ontario Ministry of Northern Affairs. Hunt (1981) has previously described the aggregate resources in the Pamour Area of the City of Timmins.

In the project area, five areas containing significant amounts of sand and gravel have been selected for possible resource protection at the primary level of significance. Selected Sand and Gravel Resource Areas occupy 1670 acres (680 ha). An estimated 1070 acres (435 ha) are currently available for extraction, containing resources of approximately 110 million tons (100 million tonnes). The parts of the selected areas which are available for extraction represent 2 percent of the total area occupied by sand and gravel deposits in the study area and 6 percent of the total resource tonnage.

Selected Sand and Gravel Resource Area 1 is an esker deposit located along the King's Highway 655 in the centre of Murphy Township. The Area forms the most important natural aggregate deposit in the project area and contains an estimated 27 million tons (24 million tonnes) of sand and gravel.

Selected Sand and Gravel Resource Areas 2, 3, 4 and 5 are also esker deposits located in the study area. These Areas contain an estimated 83 million tons (75 million tonnes) of sand and gravel.

The project area has possible sand and gravel resources which should be sufficient for local needs for a considerable period of time. However, the area has limited possible resources of good-quality crushable gravel. Care should be taken to ensure the continuing availability of as much of the remaining resources as possible.

The project area is underlain predominantly by metavolcanic, metasedimentary, metamorphosed ultramafic and felsic intrusive rocks of the Precambrian Shield. Drift cover is irregular and bedrock surfaces sporadically throughout the area. The felsic intrusive rocks are generally considered the most suitable rock type available for possible extractive development. Bedrock resources selected for possible resource protection are estimated to be 450 million tons (410 million tonnes).

Selected Resource Areas are not intended to be permanent, single land use units which must be incorporated in an official planning document. They represent areas in which a major resource is known to exist. Such Resource Areas may be reserved wholly or partially for extractive development and/or resource protection within the context of the official plan.

AGGREGATE RESOURCES INVENTORY OF THE CENTRAL PART OF THE CITY OF TIMMINS[1]

BY
STAFF OF THE ENGINEERING
AND TERRAIN GEOLOGY SECTION

INTRODUCTION

Mineral aggregates, which include bedrock-derived crushed stone as well as naturally formed sand and gravel, constitute the major raw material in Ontario's road-building and construction industries. Very large amounts of these materials are used each year throughout the Province. For example, in 1980, the total tonnage of mineral aggregates extracted was 171 million tons (155 million tonnes), greater than that of any other metallic or nonmetallic commodity mined in the Province (Ontario Ministry of Natural Resources 1981).

Although mineral aggregate deposits are plentiful in Ontario, they are fixed-location, nonrenewable resources which can be exploited only in those areas where they occur. Mineral aggregates are characterized by their high bulk and low unit value so that the economic value of a deposit is a function of its proximity to a market area as well as its quality and size. The potential for extractive development is usually greatest in urban fringe areas where land use competition is extreme. For these reasons the availability of adequate resources for future development is now being threatened in some areas.

Comprehensive planning and resource management strategies are required to make the best use of available resources, especially in those areas experiencing rapid development. Such strategies must be based on a sound knowledge of the total mineral aggregate resource base at both local and regional levels. The purpose of the Aggregate Resources Inventory is to provide the basic geological information required to include potential mineral aggregate resource areas in planning strategies and official plans. The reports should form the basis for discussion on those areas best suited for possible extraction. The aim is to assist decision-makers in protecting the public well-being by ensuring that adequate resources of mineral aggregate remain available for future use.

This report is a technical background document, based for the most part on geological information and interpretation. It has been designed as a component of the total planning process and should be used in conjunction with other planning considerations, to ensure the best use of a municipality's resources.

The report includes an assessment of sand, gravel and crushed bedrock. The most recent information available has been used to prepare the report. As new information becomes available, revisions may be necessary.

[1] Manuscript accepted for publication by Chief, Engineering and Terrain Geology Section, November 30, 1982.

This paper is published with the permission of E.G. Pye, Director, Ontario Geological Survey.

PART I - INVENTORY METHODS

FIELD AND OFFICE METHODS

The methods used to prepare the report primarily involve the interpretation of published geological data such as bedrock and surficial geology maps and reports (see References) as well as field examination of potential resource areas. Field methods included the examination of natural and man-made exposures of granular material. Most observations were made at quarries and sand and gravel pits located from records held by the Ontario Ministry of Transportation and Communications, the Ontario Geological Survey, and by Regional and District Offices of the Ontario Ministry of Natural Resources. Observations made at pit sites included estimates of the total face height and the proportion of gravel- and sand-sized fragments in the deposit. Observations were also made of the shape and lithology of the particles. These characteristics are important in estimating the quality and quantity of the aggregate. In areas of limited exposure, test pitting, soil probing and hand-augering techniques were used to assess subsurface materials. Airphotos at various scales were used to determine the continuity of deposits, especially in areas where information is limited.

Deposits with potential for further extractive development or those where existing data are scarce, were studied in greater detail. Representative layers in these deposits were sampled in 25- to 100-pound (11- to 45-kg) units from existing pit faces or from test pits dug by backhoe. The samples were analysed for grain size distribution and in some cases for petrographic assemblage. Analyses were performed in the laboratories of the Soils and Aggregates Section, Engineering Materials Office, Ontario Ministry of Transportation and Communications. In areas of limited subsurface exposure, drilling using a powered hollow stem auger was undertaken. The sediments revealed in these test holes are described in Table 7. The symbols for and locations of sample and test hole sites are noted on Map 1.

In the office, the field data were supplemented by pit information on file with the Soils and Aggregate Section of the Ontario Ministry of Transportation and Communications. Data contained in these files include field estimates of the depth, composition and "workability" of deposits as well as laboratory analyses of the physical properties and chemical suitability of the aggregate. Information concerning the development history of the pits and acceptable uses of the aggregate is also recorded. The locations of additional sources were obtained from records held by Regional and District Offices of the Ontario Ministry of Natural Resources. The cooperation of the above named groups in the compilation of inventory data is gratefully acknowledged.

Water well records, held by the Ontario Ministry of the Environment, were used in some areas to corroborate thickness estimates or to indicate the presence of buried granular material. These records were used only in conjunction with other evidence. Topographic maps of the National Topographic System, at a scale of 1:50 000, were used as a compilation base for the field and office data. The information was then transferred to a base map, also at a scale of 1:50 000, prepared by the Cartography Section of the Lands and Waters Group, Ontario Ministry of Natural Resources, for presentation in the report.

RESOURCE TONNAGE CALCULATION TECHNIQUES

SAND AND GRAVEL RESOURCES

Once the interpretative boundaries of the aggregate units have been drawn, quantitative estimates of the possible resources available can be made. Generally, the volume of a deposit can be calculated if its areal extent and average thickness are known or can be estimated. The computation methods used are as follows. First, the area of the deposit, as outlined on the final base map, is calculated in acres. The thickness values used are an approximation of the deposit thickness, based on the face heights of pits developed in the deposit or on subsurface data such as test holes and water well logs. Original tonnage values can then be calculated by multiplying the volume of the deposit by 2500 (the density factor). This factor is approximately the number of tons in a one-foot (0.3-m) thick layer of sand and gravel, one acre (0.4 ha) in extent,

assuming an average density of 110 pounds per cubic foot (1766 kg per cubic metre).

Tonnage = Area x Thickness x Density Factor

Tonnage calculated in this manner must be considered only as an estimate. Furthermore, such tonnages represent amounts that existed prior to any extraction of material (i.e. original tonnage) (Table 1, Column 4).

The Selected Sand and Gravel Resource Areas in Table 3 are calculated in the following way. Two successive subtractions are made from the total area. Column 3 accounts for the number of acres unavailable due to the presence of permanent cultural features and their associated setback requirements. Column 4 accounts for those areas that have previously been extracted. The remaining figure is the area of the deposit currently available for extraction (Column 5). The available area is then multiplied by the estimated deposit thickness and the density factor (Column 5 x Column 6 x 2500) to give an estimate of the sand and gravel tonnage (Column 7) presently available for extractive development and/or resource protection.

Reserve estimates are calculated for deposits of primary significance. Reserve estimates for deposits of secondary and tertiary significance are not calculated in Table 3, however the aggregate potential of these deposits is discussed in the report.

BEDROCK RESOURCES

The method used to calculate resources of bedrock-derived aggregate is much the same as that described above. The areal extent of bedrock formations overlain by less than 25 feet (8 m) of unconsolidated overburden is determined from bedrock geology maps and from the interpretation of available subsurface data. The measured extent of such areas is then multiplied by the estimated quarriable thickness of the rock unit. In most cases a standardized estimate of a quarriable thickness of 60 feet (18 m) is used. Although the thickness of the Precambrian bedrock units in northern Ontario are all probably considerably greater, the 60-foot (18-m) value is considered an appropriate estimate of the maximum thickness of material that can be economically and technologically extracted from a given quarry face. Volume estimates are then multiplied by 3700 (the estimated weight, in Imperial tons, of a one-foot (0.3-m) thick section of Precambrian rock one acre (0.4 ha) in extent, assuming a bulk density of 170 pounds per cubic foot (2729 kg per cubic metre)).

UNITS AND DEFINITIONS

Although most of the measurements and other primary data available for resource tonnage calculations are given in Imperial units, Metric units have also been given in the text and on the tables which accompany the report. The Metric equivalent of the data is shown in brackets after or directly below the corresponding Imperial figures. Data are generally rounded off in accordance with the Ontario Metric Practice Guide (Metric Committee 1975).

The tonnage estimates made for sand and gravel as well as bedrock-derived aggregate are termed possible resources in accordance with terminology of the Ontario Resource Classification Scheme (Robertson 1975, p.7) and with the Association of Professional Engineers of Ontario (1976) (see Glossary, Appendix B).

PART II - DATA PRESENTATION AND INTERPRETATION

Three maps, each portraying a different aspect of the aggregate resources in the study area, accompany the report. Map 1, "Distribution of Sand and Gravel Deposits", gives a comprehensive inventory of the sand and gravel resources in the report area. Map 2, "Selected Sand and Gravel Resources Areas", shows those deposits which are considered to represent the largest and/or highest quality resources in the area. Map 3, "Bedrock Resources", shows the distribution of bedrock lithologies, the distribution of overlying unconsolidated sediments, and identifies the Selected Bedrock Resource Areas.

MAP 1: DISTRIBUTION OF SAND AND GRAVEL DEPOSITS

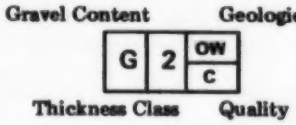
Map 1 is derived directly from existing surficial geology maps of the area or from airphoto interpretation in areas where surficial mapping is incomplete. It shows the extent and quality of sand and gravel deposits within the study area and the present level of extractive activity.

On the map, gravel deposits are indicated by dark brown shading while sand deposits are shaded light brown. The present level of extractive activity is also indicated. Pits are shown by a solid dot and identified by a number which refers to the pit descriptions in Table 2. Each description notes the owner and location of the pit, as well as the estimated face height, percentage gravel and pit status.

Map 1 also presents a summary of available information related to the quality of aggregate contained in all the known aggregate deposits in the study area. Much of this information is contained in the symbols which are found on the map. The Deposit Symbol appears for each mapped deposit and summarizes important genetic and textural data. The Texture Symbol is a circular proportional diagram which displays the grain size distribution of the aggregate in areas where bulk samples were taken.

DEPOSIT SYMBOL

The Deposit Symbol is similar to those used in soil mapping and land classification systems commonly in use in North America. The components of the symbol indicate the gravel content, thickness of material, origin (type), and quality limitations for every deposit shown on Map 1. These components are illustrated by the following example:



This symbol identifies an outwash deposit 10 to 20 feet (3 to 6 m) thick containing more than 35 percent gravel. Excess silt and clay may limit uses of the aggregate in the deposit.

The "gravel content" and "thickness class" are basic criteria for distinguishing different deposits. The "gravel content" symbol is an upper case "S" or "G". The "S" indicates that the deposit is generally "sandy" and that gravel-sized aggregate makes up less than 35 percent of the whole deposit. "G" indicates that the aggregate probably contains more than 35 percent gravel.

The "thickness class" indicates a depth range which is related to the potential resource tonnage for each deposit. Four thickness class divisions have been established as shown in the legend for Map 1.

Two smaller sets of letters, divided from each other by a horizontal line, follow the thickness class number. The upper series of letters identify the geologic deposit type (the types are summarized with respect to their main geologic and extractive characteristics in Appendix C) and the lower series of letters identify the main quality limitations that may be present in the deposit as discussed in the next section.

TEXTURE SYMBOL

The Texture Symbol provides a more detailed assessment of the grain size distribution in deposits where samples were taken for analysis during field study. The data from which these symbols are derived has been plotted on grain size distribution graphs. The relative amounts of gravel, sand, and silt and clay in the sampled material are shown graphically by the sub-

division of a circle into proportional segments. The following example shows a hypothetical sample consisting of 30 percent gravel, 60 percent sand, and 10 percent silt and clay:

Test hole locations are shown on Map 1 by a solid drill hole symbol. The locations of described sections are indicated by a solid triangle symbol.

MAP 2: SELECTED SAND AND GRAVEL RESOURCE AREAS

Map 2 is an interpretative map derived from an evaluation of the deposits shown on Map 1. The deposits identified on Map 2 are those which are considered to be important in ensuring an adequate resource base for the future.

All the selected sand and gravel resource areas are first delineated by geological boundaries and then classified into three levels of significance: primary, secondary, and tertiary. Each area of primary significance is assessed as to its probable relative value as a resource in the report area and is given a deposit number which denotes its ranking order in that area. All such deposits are shown by dark red shading on Map 2.

Selected Aggregate Resource Areas of primary significance are not permanent, single, land use units which must be incorporated in an official planning document. They represent areas in which a major resource is known to exist. Such Resource Areas may be reserved wholly or partially for extractive development and/or resource protection within the context of the official plan.

Deposits of secondary significance are not ranked numerically in this report, but are indicated by light red shading on Map 2. Such deposits are believed to contain significant amounts of sand and gravel. Although deposits of secondary significance are not considered to be the "best" resource areas in the report area, they may contain large quantities of sand and gravel and should be considered as part of the aggregate supply of the area.

Areas of tertiary significance are outlined on the map by a solid line but have no shading. They are neither rated nor considered to be important resource areas because of their low available resources, or because of possible difficulties in extraction. Such areas may be useful for local needs but are unlikely to support large-scale development.

The process by which deposits are evaluated and selected involves the consideration of two sets of criteria. The main selection criteria are site specific, related to the characteristics of individual deposits. Factors such as deposit size, aggregate quality, and deposit location and setting are considered in the selection of those deposits best suited for extractive development. A second set of criteria involves the assessment of local aggregate resources in relation to the quality, quantity, and distribution of resources in the region in which the report area is located. The intent of such a process of evaluation is to ensure the continuing availability of sufficient resources to meet possible future demands.

SITE SPECIFIC CRITERIA

DEPOSIT SIZE

Ideally, selected deposits should contain available sand and gravel resources large enough to support a commercial pit operation using a stationary or portable processing plant. In practice, much smaller deposits may be of significant value depending on the overall reserves in the rest of the municipality. Generally, deposits in Class 1, i.e. those thicker than 20 feet (6 m) and containing more than 35 percent crushable gravel are considered to be most favourable for commercial development. Thinner deposits may be valuable in municipalities with low total resources.

AGGREGATE QUALITY

The limitations of natural aggregates for various uses result from variations in the lithology of the particles composing the deposit, and from variations in the size distribution of these particles.

Four indicators of the quality of aggregate may be included in the symbol for each deposit on Map 1. They are: gravel content (G or S), fines (C), oversize (O) and lithology (L).

Three of the indicators deal with grain size distribution. The gravel content, (G or S), indicates the suitability of aggregate for various uses. Deposits containing at least 35 percent

gravel in addition to a minimum of 20 percent material greater than the 26.5 mm sieve are considered to be the most favourable extractive sites, since this content is the minimum from which crushed products can be economically produced.

Excess fines (or high silt and clay content) may severely limit the potential use of an aggregate. Fines content in excess of 10 percent may impede drainage in road sub-base aggregate and render it more susceptible to the effects of frost action. In asphalt aggregate, excess fines hinder the bonding of particles. Deposits known to have a high fines content are indicated by a "C" in the quality portion of the Deposit Symbol.

Deposits containing more than 20 percent oversize material (greater than 4 inches (10 cm) in diameter) may also have use limitations. The oversize component is unacceptable for all concrete aggregate and for road-building aggregate, so it must be either crushed or removed during processing. Deposits known to have an appreciable oversize component are indicated by an "O" in the quality portion of the Deposit Symbol.

The other indicator of the quality of an aggregate is lithology. Just as the unique physical and chemical properties of bedrock types determine their value for use as crushed rock, so do various lithologies of particles in a sand and gravel deposit determine its suitability for various uses. The presence of objectionable lithologies such as chert, siltstone, and shale, even in relatively small amounts, can result in a reduction in the quality of an aggregate, especially for high-quality uses such as concrete and asphalt. Similarly, highly weathered, very porous and friable rock can restrict the quality of an aggregate. Deposits known to contain objectionable lithologies are indicated by an "L" in the quality component of the Deposit Symbol.

If the Deposit Symbol indicates either "C", "O", or "L" or any combination, the quality of the deposit is considered to be reduced for some uses of the aggregate. No attempt has been made to quantify the degree of limitation imposed. Assessment of the four indicators is made from published data, from data contained in files of the Ontario Ministry of Transportation and Communications and the Engineering and Terrain Geology Section of the Ontario Geological Survey, and from field observations.

Analyses of unprocessed samples obtained from test holes or pits have been plotted on grain size distribution graphs. On the graphs are the gradation specification envelopes for Ontario Ministry of Transportation and Communications' products: Granular Base Course A, B and C; and Hot-Laid Asphaltic Sand Nos. 1, 2, 3, 4, 5, 6 and 8. By plotting the gradation curves with respect to the specification envelopes, it can be determined how well the unprocessed sampled material meets the criteria for each product.

LOCATION AND SETTING

The location and setting of a resource area has a direct influence on its value for possible extraction. The evaluation of a deposit's setting is made on the basis of natural and man-made features which may limit or prohibit extractive development.

First, the physical context of the deposit is considered. Deposits with some physical constraint on extractive development, such as thick overburden or high water table, are less valuable resource areas, because of the difficulties involved in resource recovery. Second, permanent man-made features, such as roads, railways, powerlines, and housing developments, which are built on a deposit, may prohibit its extraction. The constraining effect of legally required setbacks surrounding such features is included in the evaluation. A quantitative assessment of these constraints can be made by measurement of their areal extent directly from the topographic maps. The area rendered unavailable by these features is shown for each resource area in Table 3 (Column 3).

The assessment of sand and gravel deposits and bedrock resource areas with respect to local land use and to private land ownership is an important component of the general evaluation process. These aspects of the evaluation process are not considered further in this report, but readers are encouraged to discuss them with personnel of the pertinent District Office of the Ontario Ministry of Natural Resources.

REGIONAL CONSIDERATIONS

In selecting sufficient areas for resource development, it is important to assess both the

local and the regional resource base, and to forecast future production and demand patterns.

Some appreciation of future aggregate requirements in an area may be gained by assessing its present production levels and by forecasting future production trends. Such an approach is based on the assumptions that production levels in an area closely reflect the demand and that the present production "market share" of an area will remain roughly at the same level.

The aggregate resources in the region surrounding a municipality should be assessed in order to properly evaluate specific resource areas and to adopt optimum resource management plans. For example, a municipality that has large resources in comparison to its surrounding region constitutes a regionally significant resource area. Municipalities with high resources in proximity to large demand centres, such as metropolitan areas, are special cases.

Although an appreciation of the regional context is required to develop comprehensive resource management techniques, such detailed evaluation is beyond the scope of this report. The selection of resource areas made in this study is based primarily on geological data or on considerations outlined in preceding sections.

MAP 3: BEDROCK RESOURCES

Map 3 is an interpretative map derived from bedrock geology maps, water well data from the Ontario Ministry of the Environment, drilling assessment data from the Ontario Ministry of Natural Resources and from the Northern Ontario Engineering Geology Terrain Studies produced for the Ontario Geological Survey. Map 3 is based on concepts similar to those outlined for Maps 1 and 2, but displays both the inventory and evaluation on the one map.

The geological boundaries of the bedrock units are shown by a dashed line. Areas where bedrock outcrops, or is within 3 feet (1 m) of the ground surface are indicated by dark blue shading. Isolated bedrock outcrops which lie outside these areas are indicated by a black "X" symbol. These areas constitute potential resource areas of primary significance, because of their easy access. Areas where the bedrock is covered by 3 to 25 feet (1 to 8 m) of drift are indicated by light blue shading. Quarrying is possible in this depth of overburden and these also represent potential resource areas. Outside the delineated areas of thin drift cover, the bedrock is generally overlain by more than 25 feet (8 m) of drift. These areas constitute resources which have extractive value only in specific circumstances and it is unlikely these areas will constitute resource areas of economic significance.

Other inventory information presented on Map 3 is designed to give an indication of the present level of extractive activity in the report area. All known quarries are shown by a dot symbol and identified by a number which refers to the quarry descriptions in Table 5. Each description notes the owner, location and an estimate of face height. One additional symbol appears on the map: an open dot indicates the location of a selected drill hole which penetrates bedrock. The overburden thickness is shown in feet beside the open dot.

SELECTION CRITERIA

Criteria equivalent to those used for sand and gravel deposits are used to select bedrock areas most favourable for extractive development.

The evaluation of bedrock resources is made primarily on the basis of performance and suitability data established by laboratory testing at the Ontario Ministry of Transportation and Communications. The main characteristics of the bedrock units found in the study area are summarized in Appendix D.

Deposit "size" is related directly to the areal extent of thin drift cover overlying favourable bedrock formations. Quality of the aggregate derived from specific bedrock units is established by the performance standards previously mentioned. Location and setting criteria and regional considerations are identical to those for sand and gravel deposits.

SELECTED RESOURCE AREAS

Selection of bedrock resource areas has been restricted to a single level of significance. Two factors support this approach. First, the areal extent of a given quarry operation is much smaller than that of a sand and gravel pit producing an equivalent tonnage of material, and second, since crushed bedrock has a higher unit value than sand and gravel, longer haul distances

can be considered. These factors allow the identification of alternative sites having similar development potential. The selected areas are shown on Map 3 by a line pattern and the calculated available tonnages are given in Table 6.

It should be stressed, that the Precambrian Shield rocks in northern Ontario are generally more complex and variable than the Paleozoic rocks of southern Ontario. They often show wide variations in mineralogy, texture (grain size) and degree of weathering, even within specific rock types and over relatively short distances. As these factors are considered important in determining the suitability of the bedrock for use as aggregate, the aggregate potential may also vary considerably from location to location.

Careful selection is especially important if the bedrock is to be used as concrete aggregate. Deleterious chemical reactions may develop in the concrete which can lead to its eventual deterioration. Fortunately, these chemical reactions should not influence the use of bedrock-derived aggregate for hot-laid asphaltic and road-base material. However, highly weathered, very porous and friable rock should be avoided for all uses.

For these reasons, the total area selected as a bedrock resource should not be considered acceptable for aggregate use. They are, however, areas in which the probability of finding a supply of acceptable aggregate is considered most likely.

Selected Bedrock Resource Areas shown on Map 3 are not permanent, single land use units which must be incorporated in an official planning document. They represent areas in which a major bedrock resource is known to exist. Such a Resource Area may be reserved wholly or partially for extractive development and/or resource protection within the context of the official plan.

PART III - ASSESSMENT OF AGGREGATE RESOURCES IN THE CENTRAL PART OF THE CITY OF TIMMINS

LOCATION AND POPULATION

The study area occupies approximately 161,000 acres (65 000 ha) in the central part of the City of Timmins. The area consists of Wark, Murphy, Tisdale, Mountjoy, Deloro, Ogden and Price townships which are located in Cochrane District. The area is covered by the Pamour (42 A/11) and Timmins (42 A/6) map sheets of the National Topographic System, at a scale of 1:50 000.

The population of the report area was 13 671 in 1980. Figures from previous years indicate that the population has increased by approximately 15 percent since 1973 (Ron Peterson, Director of Planning, City of Timmins, personal communication, 1981). Much of this growth has been due to the development of trailer parks in Ogden, Mountjoy and Tisdale townships. Urban areas in Mountjoy and Tisdale townships account for 72 percent of the area's population. The urban areas include the Timmins City core (previously the Town of Timmins), Mountjoy, Schumacher and South Porcupine. In 1980 there were no permanent residents in Wark, Murphy or Price townships.

Access to sand and gravel resources within the project area is provided by the King's Highways 101, 655, 629 and 576. Paved, gravel-surfaced and bush or logging roads also supply access. Areas of poor access include parts of Price and Wark townships. Two lines of the Ontario Northland Railway traverse the area.

PHYSIOGRAPHY AND SURFICIAL GEOLOGY

The physiography and distribution of unconsolidated sediments including sand and gravel deposits, are largely the result of glacial activity during the Wisconsinan Stage of the Pleistocene Epoch. This period of time, which lasted from approximately 100 000 to 7000 years ago, was marked by the repeated advance and melting back of massive, continental ice sheets.

The oldest surficial sediment in the Timmins area has been referred to informally as the "lower till" by Hughes (1965) and may be the correlative of the Adam Till exposed in the Moose River basin (Skinner 1973). This "lower till", deposited as the ice advanced to the south, is sporadically seen at the surface throughout the study area. In many areas the till has been reworked by glaciolacustrine action. It is a stony, silty sand to sand till which in places may be suitable for some low-specification construction products. It has been extracted for fill in the northwestern corner of Mountjoy Township.

As the ice front retreated northward, waters of proglacial Lake Barlow-Ojibway inundated the area. Sand and gravel was deposited in the form of esker complexes as meltwaters flowed under the ice and exited into the lake at the ice margin. These complex features usually consist of a series of segmented esker ridges flanked by deltaic sediments. The esker ridges may have been deposited at or near the terminus of subglacial streams that flowed into Lake Barlow-Ojibway (Richard 1981; Tucker, in prep.). Three types of sediments are generally exposed in the ridges:

1. massive- to parallel-bedded medium to coarse gravel with occasional coarse sand layers.
2. irregularly stratified sand and gravel in which the gravel occurs as pockets or lenses within the sandy sediment. This material may overlie and flank type 1 sediment.
3. well stratified fine to coarse sand with occasional gravel pockets or layers. The sand may overlie and flank type 1 and 2 sediment.

The deltaic sediments are similar in nature to the aforementioned type 3 esker sediment as they consist of sand with occasional pockets or layers of gravel. The deltaic material is often crossbedded and usually becomes finer the further it is from the esker ridges. The deltas were probably deposited as the strength of flow decreased away from the exit of subglacial streams into Lake Barlow-Ojibway. They were deposited in close proximity to the ice margin and the present-day surface exhibits a kettle topography.

The majority of the aggregate in the study area was deposited in two north-south trending esker complexes. The most utilized aggregate source in the City of Timmins has been the

Papakomeka-Pamour esker complex (Richard 1981). It extends from Wark Township in the north, along King's Highway 655, to Deloro Township in the south. In Mountjoy, Ogden and Deloro townships the deltaic facies of the complex predominates and only isolated esker segments exist. The Grassy River esker complex (Richard 1981) is situated along the east bank of the Grassy River in Price Township and extends north into Ogden and Mountjoy townships. Both esker complexes occur along major fault controlled valleys. Several smaller, isolated deltaic deposits are also located in the study area. They may be capable of supplying aggregate for local use.

The subglacial streams which provided the source material for the esker complexes also carried silt and clay which was deposited in the deep waters of Lake Barlow-Ojibway as either varved or massive silt and clay. The glaciolacustrine silt and clay is found throughout the project area and in places may overlie esker complex sediments and lower till. This fine material has no value as aggregate.

The esker complexes and lower till provided the source material for the large expanses of shallow water sand within the study area (Tucker, in prep.). The glaciolacustrine sands have low value as aggregate because of their fine texture. In certain areas, they may blanket the esker complexes, lower till and deep water glaciolacustrine deposits. As the lake level lowered, nearshore features, such as beaches and bars, were deposited (Tucker, in prep.). Sedimentation occured mainly along the esker complexes and around prominent bedrock knobs. Some of the beach deposits may be suitable for small-scale extraction.

During a late stage of the existence of the lake, the ice readvanced and deposited the Cochrane till (upper till) (Hughes 1959, 1965). The ice readvanced as far south as Wark Township and overrode previously deposited sediments. It deposited a silty clay to clay till which has no value as aggregate.

After the waters of Lake Barlow-Ojibway drained, the glaciolacustrine sands became susceptible to postglacial wind erosion and transport. Deposition of eolian sand occured mainly in the form of parabolic dunes (Tucker, in prep.). Dune sand is especially abundant in east-central Price Township and north of Flynn Lake in Deloro Township. At one location in Deloro Township fine dune sand is extracted for use as mine backfill.

The deposition of alluvium and the development of numerous swamps has also modified the physiography of the project area. Alluvium occurs along the course of existing creeks and rivers. Swamps occur extensively in low lying areas underlain by glaciolacustrine deep water sediments or Cochrane till.

EXTRACTIVE ACTIVITY

Numerous sand and gravel pits have been opened in the study area. The majority are located in two esker complexes that trend north-south through the study area. At the time of writing, 27 pits were active, active on demand, or showed signs of recent extraction.

Extensive extraction has occured in the esker ridge located in northern Tisdale Township. From 1927 to the end of 1958, over 22 million tons (20 million tonnes) of sand and gravel was extracted from one large pit and several smaller pits situated in the ridge (Ferguson 1968). The sand and gravel was used predominantly as backfill for Hollinger and McIntyre mines. In the early stages of the operation, aggregate was transported to the mines by rail. However, after 1957, diesel trucks and an aerial tramway were used. Aggregate has been extracted from other pits in the project area for mine backfill. Presently, hydraulic fill using mine tailings is employed by most mines and vast quanities of sand and gravel are no longer required. Currently, sand is being extracted from only one pit in Deloro Township for use as mine backfill.

SELECTED SAND AND GRAVEL RESOURCE AREAS

The sand and gravel deposits selected for possible resource protection in the project area are shown on Map 2. Three esker segments in Murphy and Tisdale townships, and three esker segments in Mountjoy, Ogden and Price townships have been selected as Sand and Gravel Resource Areas of Primary Significance. In addition, several deposits have been selected as Sand and Gravel Resource Areas of Secondary Significance.

Petrographic examination of the coarse aggregate from several samples taken in the

project area revealed that the aggregate is suitable for granular base course and 5/8 inch (16 mm) Crushed Stone, but its use as hot-laid asphaltic stone and concrete stone is restricted when extracted from some pits. The presence of soft and friable clasts is variable and is the major limiting factor in respect to petrographic quality. The petrographic examinations also revealed minor quanities of chert in the samples, although Hunt (1981) reports that the chert content may be as high as 7 percent in some pits.

In many instances, the depth of sand and gravel in the Selected Resource Areas exceeds 100 feet (30 m) as indicated by water well and overburden drill hole data. These depths often do not reflect the actual depth of extraction because of economic and engineering considerations. Also, the quality of the aggregate may vary at depth. As a result, the average deposit thickness used in the resource tonnage calculations is based largely on the face heights present in pits located within the Resource Areas together with a variety of test hole, section and geotechnical bore hole* data as available. Where pits were not present these subsidary data sources provided the bulk of the information on which the calculations are based.

The Selected Sand and Gravel Resource Areas of Primary Significance occupy a total available area of 1070 acres (435 ha). They contain possible sand and gravel resources of approximately 110 million tons (100 million tonnes). The available portions of the selected areas represent 2 percent of the total area of sand and gravel deposits in the study area, and 6 percent of the total resource tonnage (Tables 1 and 3). The selected areas contain most of the possible resources of crushable gravel in the study area and are usually bush covered.

SELECTED SAND AND GRAVEL RESOURCE AREA 1

Selected Sand and Gravel Resource Area 1 is an esker ridge located along the King's Highway 655 in the central part of Murphy Township. This Resource Area is a segment of the Papakomeka-Pamour esker and has local relief of 20 to 75 feet (6 to 23 m). The esker ridge has been subdivided into two separate areas based on sand and gravel content.

*Geotechnical bore hole data were obtained from the assessment files at the Resident Geologist's Office at the Ministry of Natural Resources, Timmins.

Area 1a is the northern portion of the esker situated southwest of Bigwater Lake. Coarse gravel and large erratics are exposed on its surface and subsurface data indicate the gravel is present at depth. Two pits have been opened in this Area, one of which is currently active (pit no. 8). A 25-foot (8-m) face in pit no. 8 exposes 22 feet (7 m) of medium to coarse gravel overlain by 3 feet (1 m) of stratified sand and sandy gravel. Sand pockets are occasionally present within the gravel. A sample taken from this pit revealed 80 percent gravel (Figures 2a and 2b). The aggregate from this pit is crushable and is suitable for a wide range of construction products. Some oversize material is present and may require removal or processing. Gravel similar to that revealed in pit no. 8 is also exposed in the northern end of the Area at pit no. 7 and near the Area's southern boundary at test hole TI-TH-2.

Area 1b forms the southern portion of the esker ridge. Material exposed on the ridge is predominantly sand, but, in some places, the sand may overlie and mask coarser aggregate. No pits have been opened in the Area and test holes provide the only source of subsurface information. Test hole TI-TH-3 situated in the northern part of the deposit revealed 35 feet (11 m) of sand. The Ontario Ministry of Transportation and Communications (M.T.C.) has also tested the area surrounding the test hole and found mainly sand, although small quantities of gravel are available from a beach ridge that trends north-south along the esker. Considerable quantities of gravel may be available in the area surrounding test hole TI-TH-4 as it uncovered 27 feet (8 m) of fine to coarse gravel overlain by 15 feet (5 m) of coarse sand. Gravel may underlie other portions of Area 1b, however, further subsurface testing is required.

Resource Area 1 occupies 350 acres (142 ha). Cultural constraints and previous extraction reduce the area currently available to 265 acres (107 ha). Assuming an average thickness of 35 feet (11 m) for Area 1a and 45 feet (14 m) for Area 1b available sand and gravel resources are estimated to total 27 million tons (24 million tonnes). Resource Area 1 is readily accessible via King's Highway 655.

SELECTED SAND AND GRAVEL RESOURCE AREA 2

Sand and Gravel Resource Area 2 is an esker deposit that trends southwest along King's

Highway 655 in Murphy and Tisdale townships. The esker ridge rises up to 90 feet (27 m) above the surrounding terrain. The southernmost portion of the esker segment has not been selected at the primary level as only small quantities of sand remain because of previous, extensive extraction for mine backfill. Eight pits have been developed in the Resource Area, six of which are currently active or show signs of recent extraction (pit nos. 21, 22, 23, 24, 25 and 27). Area 2 has been classified as a gravel deposit, but the overall gravel content is marginal.

Generally, faces in the pits expose 15 to 70 feet (5 to 21 m) of irregularly stratified sand and gravel. Gravel is found predominantly in pockets and lenses within the sandy sediment. The material is suitable for Granular Base Course A and C, as well as Hot-Laid No. 4 stone. It has been used for crushing, although selection and sand control are required. The sand fraction of aggregate usually requires blending for hot-laid asphaltic sand. In the southern half of the Resource Area, the irregularly stratified sand and gravel may be overlain by 10 to 20 feet (3 to 6 m) of well stratified, fine to coarse sand.

In pit no. 23, the sediments described in the previous paragraph overlie and flank poorly sorted, medium to coarse gravel. Up to 35 feet (11 m) of this good-quality, crushable gravel is exposed in the lower portions of the pit's western face. A sample taken from this face revealed 76 percent gravel (Figures 2a and 2b). The aggregate from this pit has been used for 5/8 inch (16 mm) Crushed A for concrete and asphalt, Granular Base Course A, B and C, and Hot-Laid No. 4 stone. The sand fraction, however, requires blending for some grades of asphaltic sand. In addition, some oversize material is present which requires processing or removal, and water has to be pumped from the pit floor. At the time of field investigation the pit was near depletion.

Good-quality gravel similar to that exposed in pit no. 23 may underlie other areas in this deposit. Detailed subsurface exploration is required to delineate these areas.

Resource Area 2 occupies 235 acres (95 ha), of which 90 acres (36 ha) are presently available for extraction. Assuming an average deposit thickness of 50 feet (15 m), resources of sand and gravel are estimated to be 11 million tons (10 million tonnes). The Resource Area is easily accessible via King's Highway 655 and is well situated with respect to local demand centres in the city.

SELECTED SAND AND GRAVEL RESOURCE AREA 3

Selected Sand and Gravel Resource Area 3 is a segment of the Grassy River esker that trends southward through southwestern Mountjoy Township into northern Ogden Township. The esker deposit rises up to 65 feet (20 m) above the surrounding terrain and is approximately 1.5 miles (2.4 km) in length. Five pits have been developed in the Resource Area; one pit (no. 51) is currently active. Faces in the pits expose up to 60 feet (18 m) of variable sediment ranging from fine sand with silt layers to lenses or pockets of coarse gravel.

Gravel pockets are relatively abundant in pit nos. 49 and 51 and are occasionally present in pit no. 47. Pit nos. 48 and 53 are chiefly sand sources. The gravel within the pockets may be suitable for crushing, although, selection and sand control would be required. A gravel pocket was sampled from pit no. 49 and found to contain 54 percent gravel (Figures 3a and 3b). The M.T.C. report that the coarse aggregate available in this pit is suitable for Granular Base Course A and C, as well as Hot-Laid No. 4 stone. The sand fraction of the aggregate available from the pits in Resource Area 3 generally grades too fine for hot-laid asphaltic sand. Consequently, some blending is required for this use. Silty sections are present in most of the pits and should be avoided.

Resource Area 3 occupies 200 acres (81 ha), of which 100 acres (40 ha) are currently available for extraction. Assuming an average deposit thickness of 50 feet (15 m) throughout the Area, resources of sand and gravel are estimated to be 12 million tons (11 million tonnes). The Resource Area is accessible via King's Highways 101 and 576 and is well situated with respect to local markets within the city.

SELECTED SAND AND GRAVEL RESOURCE AREA 4

Selected Sand and Gravel Resource Area 4 consists of two segments of the Grassy River esker, situated along the banks of the Grassy River in Price Township and along the Mattagami River in Ogden Township. Data for

the Area indicate that the esker contains sandy aggregate, although, in places quantities of medium to coarse gravel may be available.

Two small pits have been opened in the northern part of the Area. Aggregate has been recently removed from pit no. 59 with faces exposing 12 feet (4 m) of medium gravel interbedded with fine to medium sand. The gravel layers are variable and occur as pockets or lenses within the sand. Gravel is also exposed in pit no. 58 where faces reveal 5 feet (2 m) of fine to medium gravel underlain by 5 feet (2 m) of fine sand. Although no quality data are available for the pits, it is likely that pit-run granular base course and fill may be the most readily produced aggregate.

Elsewhere in the Area, test holes and sections provide additional sources of subsurface information. Two test holes were placed in the deposit. Test hole TI-TH-8 uncovered 30 feet (9 m) of medium sand over till. The other test hole (TI-TH-10) revealed 50 feet (15 m) of fine to coarse sand. Sand was also observed in a road-cut situated just north of test hole TI-TH-10 at described section TI-DS-1.

In Price Township, the Grassy River has, in places, cut into the sides of the esker. These cuts reach heights of up to 100 feet (30 m) generally exposing slumped sand. However, at described section TI-DS-4 over 10 feet (3 m) of medium to coarse gravel is exposed. This gravel may have a greater thickness and appears to contain crushable material. The coarse aggregate was sampled and found to contain 68 percent gravel (Figures 3a and 3b). In places throughout the Resource Area, coarse aggregate may also be present, so further investigation of the Area may increase its total resource potential.

Selected Resource Area 4 comprises 820 acres (330 ha), of which 560 acres (227 ha) are presently available for extraction. Assuming an average deposit thickness of 40 feet (12 m), currently available sand and gravel resources are estimated to total 56 million tons (51 million tonnes). Little extractive development has occurred in this Resource Area and poor access inhibits development in parts of the Area, especially in Price Township. Also, the position of the esker along the banks of the Grassy River in Price and in southern Ogden Township may restrict extractive development. Nevertheless, Selected Resource Area 4 is considered to be a valuable future source of sand and gravel for the Timmins area.

SELECTED SAND AND GRAVEL RESOURCE AREA 5

Selected Sand and Gravel Resource Area 5 is a small segment of the Papakomeka-Pamour esker located in south-central Murphy Township, to the east of Selected Resource Area 2. The esker in this location consists of a single ridge approximately 40 feet (12 m) high. Parts of two pits extend into this deposit (pit nos. 14 and 15). Faces in the pits range in height from 20 to 30 feet (6 to 9 m) and expose generally sandy aggregate. However, on the western face of pit no. 14, where it extends into the esker ridge, the M.T.C. has reported up to 12 feet (4 m) of fine to coarse gravel. This coarse aggregate is suitable for Granular Base Course A and B. Similar material may be present elsewhere in the deposit.

Resource Area 5 occupies 65 acres (26 ha), of which 55 acres (22 ha) are currently available for extraction. Assuming an average deposit thickness of 30 feet (9 m), presently available sand and gravel resources are estimated to be 4 million tons (4 million tonnes). The Area is accessible by gravel-surfaced roads that branch off King's Highway 655.

SAND AND GRAVEL RESOURCE AREAS OF SECONDARY SIGNIFICANCE

Several deposits located within the project area have been selected as Sand and Gravel Resource Areas of Secondary Significance. These deposits are predominantly sand sources, although small quantities of coarse aggregate may be present locally. Large possible resources of generally low-specification construction aggregate are available from these deposits. The secondary areas should be considered as part of the area's aggregate supply.

The deltaic deposits flanking the esker segments that form Resource Areas 1, 2 and 5 have been selected as Sand and Gravel Resource Areas of Secondary Significance. Typically, the deltaic sediments exposed in the deposits consist of an upper layer, usually not more than 8 feet (2 m), of sandy gravel underlain by well stratified fine to medium sand. The sediment usually becomes finer the further it is located from the esker ridges and in some pits silt seams are common

in the lower sand unit. The type of product more readily produced from these deposits includes Granular Base Course C and fill. The sand often grades fine for hot-laid asphalt and blending is required. Occasionally, some of the gravel pockets have been selectively extracted for Granular Base Course A and crushing. The esker deposit which adjoins the southernmost boundary of Resource Area 2 has also been selected at the secondary level. Only small quantities of sand are available from this part of the esker because of previous, large-scale extraction for mine backfill.

The deposit flanking the esker segment that forms Resource Area 3 in Mountjoy and Ogden townships has been selected for resource protection at the secondary level. It consists mainly of deltaic sediments although areas of glaciolacustrine sand have been noted. Six pits have been developed in this deposit and contain chiefly sandy aggregate. Pockets of gravel, however, are occasionally present, especially in the upper 10 feet (3 m) of the deposit. The aggregate from these pits is generally suitable for Granular Base Course C and fill. In some pits, silty sections are present and should be avoided. Higher-specification construction products are available from two pits in the area. Gravel pockets have been selectively extracted to produce Granular Base Course A and crushed stone in pit no. 45, but sand control and close supervision is required to obtain the coarse aggregate. In pit no. 50, 10 to 12 feet (3 to 4 m) of uniformly stratified sand and fine gravel is extracted for the manufacture of concrete blocks. A small esker segment which adjoins the northern part of this deposit has also been selected at the secondary level. Subsurface information is scarce for the esker and further testing is required to establish its quality.

A delta deposit is located near McKay Lake in Deloro Township. Two pits have been opened in the deposit and have produced some coarse aggregate. Most of the gravel has been depleted or presently lies below the water table. The remainder of the deposit consists mainly of sandy aggregate.

Lacustrine and eolian sand overlies a delta deposit located in southwestern Deloro Township. Two pits have been developed in this deposit exposing predominantly sand. An adjoining esker segment has also been selected as an area of secondary significance. Subsurface information for the esker is scarce, but quantities of coarse aggregate have been extracted from similar deposits to the south in Adams Township.

Two glaciolacustrine delta deposits situated in Wark Township contain sand which has been used for Granular Base Course C and granular borrow. Six pits have been opened in the deposits and water is present on most of the pit floors. Clayey Cochrane till, up to 10 feet (3 m) thick, overlies the sand in the southernmost deposit.

Fine to medium sand with minor quantities of fine gravel is exposed in pits situated within three isolated delta deposits in Mountjoy Township. Two of the deposits are located in the northwestern corner of the township and the third near the township's eastern boundary. Products supplied from these deposits include Granular Base Course C and fill. The exception is pit no. 38, located in the easternmost deposit, where the aggregate has been used for structural concrete. Up to 6 feet (2 m) of clay overlies the aggregate in this deposit. In the westernmost deposit, the sand and gravel is overlain by the lower till. This till has been extracted for use as fill at pit no. 44.

The western portion of a deposit, situated south of the Timmins City core, has been selected for resource protection at the secondary level. This area consists dominantly of deltaic sediments although areas of glaciolacustrine sediments have been noted. The deposit is composed of sand with minor amounts of gravel. The exception is in pit no. 66 where 8 feet (2 m) of glaciolacustrine silt and clay overlies medium to coarse gravel. The coarse aggregate from this pit has been used for Granular Base Course A and C, and Hot-Laid No. 4 stone. The pit is presently nearing depletion. The eastern portion of the deposit has not been selected as little subsurface information is available.

The final area selected at the secondary level is a delta deposit located west of the Grassy River in Ogden and Price townships. The deltaic sediments in this deposit are overlain by both glaciolacustrine and eolian sands. At described section TI-DS-2, 40 feet (12 m) of well stratified fine to medium sand with minor quantities of coarse sand and fine gravel overlies 25 feet (8 m) of very fine sand. Elsewhere in the deposit subsurface information is scarce and detailed

subsurface testing is required to determine the suitability of the aggregate. However, large quantities of sand may be available from this deposit.

BEDROCK GEOLOGY

For the most part, the bedrock in the project area is Early Precambrian (Archean) in age. The exception is some diabase dikes of Late Precambrian Age which traverse the area. The bedrock is part of the Superior Province of the Canadian Shield and consists largely of metavolcanic, metasedimentary, metamorphosed ultramafic and felsic intrusive rocks. The general bedrock geology of the Timmins area has been described by Pyke (1980) and parts of his report are paraphrased herein.

The metavolcanic rocks are divided into two groups, the Deloro and Tisdale Groups. The Deloro Group is predominantly a calc-alkaline sequence and is composed largely of andesite and basalt in the basal unit, and dacite and rhyolitic pyroclastics in the upper units. Iron formation commonly caps the group which is approximately 15,000 feet (4550 m) thick. The iron formation may be suitable for the production of crushed stone, but cherty varieties are present. Further investigation of the quality of this rock in the Timmins area is required. Iron formation has not been included on Map 3 because of its small areal extent.

A major change in volcanism marks the beginning of the Tisdale Group. The group is approximately 13,000 feet (3950 m) thick and the basal formation consists mainly of ultramafic volcanic rocks and basaltic komatiites. This is in turn overlain by a sequence of tholeiitic basalts. The upper portion is largely of calc-alkaline dacitic composition. The metavolcanic rocks are subdivided on Map 3 into intermediate and mafic (Rock Type A), and felsic (Rock Type B) varieties. These rocks have not been selected for resource protection as they are frequently sheared and some varieties are easily weathered.

The upper portion of the Deloro Group and the entire section of the Tisdale Group are time equivalent with the lower portion of the metasedimentary rocks (Rock Type C). The metasediments consist dominantly of interlayered greywacke, siltstone and lesser amounts of conglomerate, and form part of what is mainly a turbidite sequence. This 10,000-foot (3050-m) sequence is referred to as the Porcupine Group. A small body of metasedimentary rock situated in east-central Tisdale Township contains a higher proportion of conglomerate.

Greywacke has been found suitable for the production of crushed stone in other parts of northern Ontario. However, as some varieties of greywackes are chemically reactive with cement and because performance information on greywackes from this area is lacking, this type of rock has not been selected for resource protection in the project area.

Sill-like bodies of metamorphosed ultramafic rocks (Rock Type D) were emplaced almost entirely within the Deloro group of metavolcanics. They have little value as aggregate because they are easily weathered. A small body of metamorphosed mafic rock (Rock Type E) is situated in southern Deloro Township. It consists largely of gabbro and diorite. These rock types are generally suitable for extractive development but have not been selected as only a small portion of the body is overlain by less than 25 feet (8 m) of drift.

The metavolcanic and metasedimentary rocks were subsequently intruded by felsic rocks (Rock Type F). Granodiorite is the most abundant intrusive rock in the area. The largest expanses occur in Price Township and it forms small stocks in central Deloro Township and south-central Ogden Township. The granodiorite is usually medium grained and massive to weakly foliated. In Tisdale Township, small bodies of quartz-feldspar porphyries intruded the metavolcanic rocks. The porphyries are light green-grey and moderately to strongly foliated rocks.

The felsic intrusive rocks are considered the most suitable rocks in the area for possible extraction. These rocks are usually hard and relatively homogeneous, but brittle varieties should be avoided. Also, some of these rocks with a high feldspar and quartz content have "stripping" problems, in that the smooth cleavage and fracture surfaces of the minerals hinder the adhesion of asphalt and concrete mixes. This problem can be circumvented by weathering the rocks for a period of time in stockpiles or by adding chemicals which erode the smooth surfaces and allow better adhesion. Six areas of thinly drift-covered felsic intrusive

rocks have been selected for possible resource protection in the project area.

Diabase dikes cut the aforementioned rock types in the study area. They range in age from Early to Late Precambrian and both quartz- and olivine-bearing varieties occur. The north-south, north-northwest and northeast trending dikes consist mainly of quartz diabase (Rock Type G). It is generally hard and massive and has been found suitable for quarry development elsewhere in northern Ontario. In the Timmins area the dikes are generally too thin for economic extraction. A minimum width of approximately 50 feet (15 m) is required for extraction unless the surrounding rocks are also suitable for extraction (Zoltan Katona, Senior Aggregate Resource Engineer, M.T.C., Toronto, personal communication, 1981). The olivine-bearing diabase dikes (Rock Type H) trend northwest and east-northeast across the project area. The olivine diabase weathers too easily for use as construction aggregate.

At this point in time, the Aggregate Assessment Office would emphasize that for any site proposed for quarry development, the site should be tested in detail before extractive development occurs. The Precambrian rocks may vary in quality over relatively short distances and may be chemically reactive with concrete mixes.

Since the project area has considerable resources of sand and gravel, the bedrock is not expected to be required until the sand and gravel is near depletion. In the meantime, crushed bedrock could possibly be used to beneficiate sand sources, especially if the bedrock lies close to a sand deposit. Waste rock from mines in the area may also be suitable for some aggregate uses. It has previously been used as railway base material. For the most part, however, the waste rock is not considered well suited for use as aggregate in concrete because of its frequent highly mineralized and sheared nature. A more detailed study of the suitability of the waste rock should be undertaken.

SELECTED BEDROCK RESOURCE AREA 1

Selected Bedrock Resource Area 1 consists of six areas, labelled 1a to 1f on Map 3. All areas contain Type F bedrock with the exception of some small diabase dikes which cut across Area 1b to 1e. Areas 1a and 1b are small areas located in central Deloro Township and south-central Ogden Township, respectively. Larger expanses of bedrock are available from Areas 1c to 1f situated in the central and southeastern parts of Price Township. The bedrock surface in all areas is irregular, but for the most part is overlain by less than 25 feet (8 m) of drift. Less than 3 feet (1 m) of drift overlies the bedrock in Area 1a and a small portion of Area 1c. Isolated bedrock outcrops occur in most of the areas.

The total area occupied by Resource Areas 1a to 1f is 2250 acres (910 ha). An estimated 2020 acres (820 ha) are presently available for extraction. Assuming an average quarriable thickness of 60 feet (18 m), presently available bedrock resources are estimated to be 450 million tons (410 million tonnes). The Resource Areas are not readily accessible by road and are bush covered.

SUMMARY

The central part of the City of Timmins has resources of sand and gravel which should be sufficient to meet local needs for a considerable period of time. However, possible resources of good-quality crushable gravel are limited. Although several deposits have been selected for resource protection at the primary and secondary levels, careful management is necessary to preserve as much of the resources as possible.

The project area is underlain predominantly by metavolcanic, metasedimentary, metamorphosed ultramafic and felsic intrusive rocks of Precambrian age. The felsic intrusive rocks are generally considered the most suitable of these rock types for the production of road-building and construction aggregates. These areas may be of importance for extraction when resources of crushable gravel become scarce.

Enquiries regarding the Aggregate Resources Inventory of the central part of the City of Timmins should be directed to the Ontario Ministry of Natural Resources either at the Timmins District Office, 896 Riverside Drive, Timmins, Ontario, P4N 3W2 (Tel. (705) 267-7951) or at the Northern Region Sub-Office, 60 Wilson Avenue, Timmins, Ontario, P4N 2S7 (Tel. (705) 267-1401).

TABLE 1 | TOTAL SAND AND GRAVEL RESOURCES, CENTRAL PART OF THE CITY OF TIMMINS

1 CLASS NO.	2 DEPOSIT TYPE (see Appendix C)	3 AREAL EXTENT Acres (Hectares)	4 ORIGINAL TONNAGE Millions of Tons (Tonnes)
1	G-E	285 (115)	42 (38)
	S-E	1550 (630)	160 (145)
	S-LD	6000 (2430)	450 (410)
	S-LD • LP	2650 (1070)	155 (141)
2	S-E	20 (8)	<1 (<1)
	S-LB	110 (44)	3 (3)
	S-LD	430 (174)	14 (13)
	S-LD • LP	1190 (480)	45 (41)
	S-LP	6500 (2650)	185 (168)
	S-LP • WD	10,000 (4050)	250 (227)
3	S-LD	920 (370)	20 (18)
	S-LD • LP	2480 (1000)	55 (50)
	S-LP	5100 (2060)	95 (86)
	S-LP • E	12 (5)	<1 (<1)
	S-LP • WD	6900 (2800)	150 (136)

TABLE 1 | TOTAL SAND AND GRAVEL RESOURCES, CENTRAL PART OF THE CITY OF TIMMINS

1 CLASS NO.	2 DEPOSIT TYPE (see Appendix C)	3 AREAL EXTENT Acres (Hectares)	4 ORIGINAL TONNAGE Millions of Tons (Tonnes)
4	S-AL	300 (121)	2 (2)
	S-LB	430 (174)	4 (4)
	S-LD	620 (250)	6 (5)
	S-LD • LP	1880 (760)	18 (16)
	S-LP	2500 (1010)	20 (18)
	S-LP • WD	600 (243)	6 (5)
		50,000 (20 200)	1680 (1520)

N.B. Minor variations in all tables are caused by rounding of data.

TABLE 2 | SAND AND GRAVEL PITS, CENTRAL PART OF THE CITY OF TIMMINS

1 NO.	2 MTC NO.	3 OWNER/OPERATOR	4 LOT	5 CON.	6 FACE HEIGHT Feet (Metres)	7 % GRAVEL	8 PIT STATUS
1		Texasgulf Inc., L.H. Netherton	11	5	17 (5)	5-10	inactive
2		Texasgulf Inc., L.H. Netherton	10	5	8 (2)	1-2	partially overgrown
3		Teck Corporation Ltd.	10	4	8 (2)	5	partially overgrown
4		Texas Gulf Canada Ltd., L.H. Netherton	11	2	10-20 (3-6)	5	inactive
5		Crown Land	11, 12	1, 2	10-12 (3-4)	sand	inactive
6		Crown Land	11	1, 2	10-15 (3-5)	sand	inactive
7	Pa-112-6	J. Simpson, G. Simpson	10	5, 6	15 (5)	40-60	inactive
8	Pa-112-24	G. Stringer (operated by Miller Paving Ltd.)	8	5	20-30 (6-9)	55-80	commercial source
9	Pa-112-17	J. Chartrand	6	2	20-40 (6-12)	10	active
10		Texasgulf Inc., L.H. Netherton	5, 6	2	7 (2)	5-10	partially overgrown
11		Texasgulf Inc., L.H. Netherton	5	2	12 (4)	sand	partially overgrown
12		H. Bergeron	5	2	8 (2)	sand	inactive
13	Pa-112-20	Joint ownership, Murphy Gravel	5, 6	2	15-20 (5-6)	10-15	inactive
14	Pa-112-21	Pamour-Porcupine Mines Ltd.	5, 6	1	25-30 (8-9)	5-10	inactive
15	Pa-112-9	Broulan Reef Mines Ltd.	5	1	25 (8)	10-15	inactive
16	Pa-112-18	City of Timmins	4, 5	1	15 (5)	5	inactive

TABLE 2 | SAND AND GRAVEL PITS, CENTRAL PART OF THE CITY OF TIMMINS

1 NO.	2 MTC NO.	3 OWNER/OPERATOR	4 LOT	5 CON.	6 FACE HEIGHT Feet (Metres)	7 % GRAVEL	8 PIT STATUS
17	Pa-112-19	Unknown	4, 5	6	10 (3)	sand	partially overgrown
18	Pa-112-51	H. Quinn	7	2	20 (6)	30-35	inactive
19		H. Quinn	7	1	20 (6)	10-20	inactive, presently used for stock piles
20		Cool Construction & Gravel Ltd.	7	1	15-20 (5-6)	5	inactive
21	Pa-112-37	Cool Construction & Gravel Ltd.	7	1	20-40 (6-12)	25-35 variable	commercial source
22	Pa-112-33	Leo Alaire and Sons	8	1	20-30 (6-9)	25-35	recently used
23	Pa-112-25	Miller Paving Ltd.	8	1	50-70 (15-21)	40-70	commercial source
24	Pa-112-6	Miller Paving Ltd.	8	1	40-50 (12-15)	20-35	commercial source
25		W. Deluca (previously owned by Hollinger Mines Ltd.)	8	6	35-40 (11-12)	5-10	recently used
26		Cool Construction and Gravel Ltd.	9	6	15 (5)	sand	one face recently used
27		Mascoli Construction Ltd. (previously owned by Hollinger Mines Ltd.)	8	6	20 (6)	25	recently used
28		Timmins Gravel Products Ltd. (previously owned by Hollinger Mines Ltd.)	8	6	20-35 (6-11)	sand	inactive
29		City of Timmins (previously owned by Hollinger Mines Ltd.)	8	6	20-25 (6-8)	5-10	inactive

TABLE 2 | SAND AND GRAVEL PITS, CENTRAL PART OF THE CITY OF TIMMINS

1 NO.	2 MTC NO.	3 OWNER/OPERATOR	4 LOT	5 CON.	6 FACE HEIGHT Feet (Metres)	7 % GRAVEL	8 PIT STATUS
30		Multiple Owners (previously owned by Hollinger Mines Ltd.)	8, 9	5, 6	30-80 (9-24)	5-10	inactive
31	Pa-112-55	Manitoulin Transport	9	5	20-30 (6-9)	5	recently used
32		J. Chartrand	9	5	30-45 (9-14)	5-10	recently used
33		(previously owned by Hollinger Mines Ltd.)	10	4, 5	30 (9)	10-20	recently used
34	Pa-112-26	Paul Guiho Trucks and Construction Ltd.	9	4	30-50 (9-15)	5-10	active on demand
35		Paul Guiho Trucks and Construction Ltd.	9	4	8 (2)	10-15	active on demand
36		Pamour Porcupine Mines Ltd.	9	4	15 (5)	5	recently used
37		City of Timmins	9	4	10-15 (3-5)	5	partially overgrown
38	Pa-112-13	Timmins Gravel Products Ltd.	1	4	20 (6)	sand	inactive
39		Unknown	1	4	20 (6)	sand	inactive
40	Pa-112-30	S. Perello	2	4	10-15 (3-5)	sand	partially overgrown
41		Unknown	9, 8	6	15-20 (5-6)	2	partially overgrown
42	Pa-112-27	F. Frappanti	9	6	10-15 (3-5)	5	recently used
43		Crown Land	12	6	4-6 (1-2)	till	recently used
44		J.V. Bonhomme Housing Ltd.	12	6	8 (2)	till over sand	inactive
45	Ti-17-1	F. Dubroy	12	2	15-25 (5-8)	10-35 variable	recently used

TABLE 2 | SAND AND GRAVEL PITS, CENTRAL PART OF THE CITY OF TIMMINS

1 NO.	2 MTC NO.	3 OWNER/OPERATOR	4 LOT	5 CON.	6 FACE HEIGHT Feet (Metres)	7 % GRAVEL	8 PIT STATUS
46		M.T.C.	11	2	15 (5)	3	inactive
47	Ti-17-2	M.T.C.	11	2	25 (8)	15-20	one face recently used
48	Ti-17-4	Timmins Sandblasting Ltd.	10	1	40-60 (12-18)	5	inactive
49	Ti-17-23	M.T.C.	11	1	8 (2)	15-30	recently used
50		Custom Concrete	11	1	10-12 (3-4)	10-35	commercial source
51	Ti-17-5	Leo Alaire and Sons	11	1	30 (9)	10-40 variable	commercial source
52		Unknown	10	1	5-9 (2-3)	sand	partially overgrown
53		L. Carr	10	F	10-15 (3-5)	5	inactive
54		Unknown	10	F	15-20 (5-6)	5-10	inactive
55		Crown Land	10	F	4 (1)	2	inactive
56	Ti-17-7	Unknown	10	E	15 (5)	3-4	inactive
57		Crown Land	9	D	25 (8)	sand	inactive
58		Crown Land and partly by F. Feldman	11	C	12-15 (4-5)	5-10	inactive
59		City of Timmins (M.N.R. Quarry permit)	11	B	12 (4)	25	recently used
60	Ti-17-10	Mascoli Construction Ltd.	1	2	20-25 (6-8)	sand	inactive

TABLE 2 | SAND AND GRAVEL PITS, CENTRAL PART OF THE CITY OF TIMMINS

1 NO.	2 MTC NO.	3 OWNER/OPERATOR	4 LOT	5 CON.	6 FACE HEIGHT Feet (Metres)	7 % GRAVEL	8 PIT STATUS
61		Unknown	1	1	20-30 (6-9)	sand	active
62	Ti-17-11	Unknown	10	1	8-25 (2-8)	sand	partially overgrown
63	Ti-17-12	Unknown	9	1	15-20 (5-6)	sand	partially overgrown
64	Ti-17-13	Unknown	9	1	10-20 (3-6)	sand	recently used, near depletion
65		Unknown	1, 2	1	35 (11)	10	inactive
66	Ti-17-25	C. Kean	1	F	30 (9)	20-30	recently used, near depletion
67	Ti-17-26	New Hope Porcupine Gold Mine Ltd.	2	F	30-35 (9-11)	5-10	inactive
68	Ti-17-67	Buffalo Ankerite	6, 7	E, D	3-18 (1-6)	15	inactive, depleted
69		Unknown	9	D	30-35 (9-11)	sand	active, used for mine backfill
70	Ti-17-15	City of Timmins	7	D	4-6 (1-2)	20	inactive
71		Romfield Building Corp. Ltd.	7	D	15 (5)	15-20	inactive
72		Unknown	7	C	5 (2)	10-15	inactive
73		Dayton Porcupine Mines Ltd.	8	C	5 (2)	sand	inactive
74		Dayton Porcupine Mines Ltd.	11	B	8-10 (2-3)	10-15	inactive
75		Dayton Porcupine Mines Ltd.	11	B	15 (5)	15	inactive

TABLE 3 | SELECTED SAND AND GRAVEL RESOURCE AREAS, CENTRAL PART OF THE CITY OF TIMMINS

1 DEPOSIT NO.	2 AREA Acres (Hectares)	3 CULTURAL SETBACKS Acres (Hectares)	4 EXTRACTED AREA Acres (Hectares)	5 AVAILABLE AREA Acres (Hectares)	6 ESTIMATED DEPOSIT THICKNESS Feet (Metres)	7 AVAILABLE AGGREGATE Millions of Tons (Tonnes)
1a	150 (61)	30 (12)	25 (10)	95 (38)	35 (11)	8 (7)
1b	200 (81)	30 (12)	0 (0)	170 (69)	45 (14)	19 (17)
2	235 (95)	50 (20)	95 (38)	90 (36)	50 (15)	11 (10)
3	200 (81)	45 (18)	55 (22)	100 (40)	50 (15)	12 (11)
4	820 (330)	250 (101)	10 (4)	560 (227)	40 (12)	56 (51)
5	65 (26)	5 (2)	5 (2)	55 (22)	30 (9)	4 (4)
	1670 (680)	410 (166)	190 (77)	1070 (435)		110 (100)

TABLE 4 | TOTAL IDENTIFIED BEDROCK RESOURCES, CENTRAL PART OF THE CITY OF TIMMINS*

1 DRIFT THICKNESS Feet (Metres)	2 BEDROCK LITHOLOGY	3 QUARRIABLE THICKNESS Feet (Metres)	4 AREAL EXTENT Acres (Hectares)	5 ORIGINAL TONNAGE Millions of Tons (Tonnes)
0-3 (0-1)	Type A	60 (18)	2850 (1150)	630 (570)
3-25 (1-8)	Type A	60 (18)	12,400 (5000)	2750 (2500)
			15,200 (6200)	3400 (3100)
0-3 (0-1)	Type B	60 (18)	1110 (450)	246 (223)
3-25 (1-8)	Type B	60 (18)	2300 (930)	510 (465)
			3400 (1380)	760 (690)
3-25 (1-8)	Type B. C	60 (18)	1110 (450)	246 (223)
0-3 (0-1)	Type C	60 (18)	115 (46)	26 (24)
3-25 (1-8)	Type C	60 (18)	2800 (1130)	620 (560)
			2900 (1170)	650 (590)
0-3 (0-1)	Type D	60 (18)	620 (250)	138 (125)
3-25 (1-8)	Type D	60 (18)	1030 (415)	229 (208)
			1650 (670)	365 (330)
0-3 (0-1)	Type E	60 (18)	10 (4)	2 (2)
3-25 (1-8)	Type E	60 (18)	10 (4)	2 (2)
			20 (8)	4 (4)

TABLE 4 TOTAL IDENTIFIED BEDROCK RESOURCES, CENTRAL PART OF THE CITY OF TIMMINS*

1 DRIFT THICKNESS Feet (Metres)	2 BEDROCK LITHOLOGY	3 QUARRIABLE THICKNESS Feet (Metres)	4 AREAL EXTENT Acres (Hectares)	5 ORIGINAL TONNAGE Millions of Tons (Tonnes)
0-3 (0-1)	Type F	60 (18)	175 (71)	39 (35)
3-25 (1-8)	Type F	60 (18)	3150 (1280)	700 (640)
			3300 (1340)	740 (670)
0-3 (0-1)	Type H	60 (18)	40 (16)	9 (8)
3-25 (1-8)	Type H	60 (18)	330 (134)	73 (66)
			370 (150)	82 (74)
			28,000 (11 300)	6200 (5600)

*Bedrock resources of Type G rock (quartz-bearing diabase dikes) are omitted on these tables because of the dike's small areal extent.

TABLE 5 | QUARRIES, CENTRAL PART OF THE CITY OF TIMMINS

1 NO.	2 MTC NO.	3 OWNER/OPERATOR	4 LOT	5 CON.	6 FACE HEIGHT Feet (Metres)	7 QUARRY STATUS

– NONE –

TABLE 6 | SELECTED BEDROCK RESOURCE AREAS, CENTRAL PART OF THE CITY OF TIMMINS

1 DEPOSIT NO.	2 DEPTH OF OVERBURDEN Feet (Metres)	3 AREA Acres (Hectares)	4 CULTURAL SETBACKS Acres (Hectares)	5 EXTRACTED AREA Acres (Hectares)	6 AVAILABLE AREA Acres (Hectares)	7 ESTIMATED QUARRIABLE THICKNESS Feet (Metres)	8 AVAILABLE RESOURCES Millions of Tons (Tonnes)
1a	0-3 (0-1)	45 (18)	5 (2)	0 (0)	40 (16)	60 (18)	9 (8)
1b	3-25 (1-8)	95 (38)	10 (4)	0 (0)	85 (34)	60 (18)	19 (17)
1c	0-25 (0-8)	1380 (560)	100 (40)	0 (0)	1280 (520)	60 (18)	285 (260)
1d	3-25 (1-8)	520 (210)	70 (28)	0 (0)	450 (182)	60 (18)	100 (91)
1e	3-25 (1-8)	135 (55)	35 (14)	0 (0)	100 (40)	60 (18)	22 (20)
1f	3-25 (1-8)	75 (30)	10 (4)	0 (0)	65 (26)	60 (18)	14 (13)
		2250 (910)	230 (93)	0 (0)	2020 (820)		450 (410)

TABLE 7 | SUMMARY OF TEST HOLE DATA, CENTRAL PART OF THE CITY OF TIMMINS

Test Hole Number: TI-TH-1

Location: Wark Township, Conc. 2 & 3, Lot 11

Elevation: Approx. 825 feet (250 m) a.s.l.

Date: July 28, 1981

Depth feet (metres)	Description
0-30 (0-9)	clay till (Cochrane till)

Test Hole Number: TI-TH-2

Location: Murphy Township, Conc. 8, Lot 4

Elevation: Approx. 975 feet (295 m) a.s.l.

Date: July 28, 1981

Description: Several test holes were placed in this area by the M.T.C. (M.T.C. No. Pa-112-44). Those placed in the esker deposit up to 14 feet (4 m) of medium to coarse gravel ranging in stone content from 45 to 65 percent. Those placed to the east in the flanking delta exposed up to 15 feet (5 m) of sand with only minor amounts of gravel.

Test Hole Number: TI-TH-3

Location: Murphy Township, Conc. 4, Lot 7

Elevation: Approx. 825 feet (250 m) a.s.l.

Date: July 29, 1981

Depth feet (metres)	Description
0-30 (0-9)	clean medium sand
30-35 (9-11)	clean coarse sand

TABLE 7 | SUMMARY OF TEST HOLE DATA, CENTRAL PART OF THE CITY OF TIMMINS

Test Hole Number: TI-TH-4

Location: Murphy Township, Conc. 3, Lot 7

Elevation: Approx. 1000 feet (305 m) a.s.l.

Date: July 30, 1981

Depth feet (metres)	Description
0-10 (0-3)	clean coarse sand
10-15 (3-5)	clean coarse sand with minor amounts of fine gravel
15-20 (5-6)	fine to medium gravel
20-25 (6-8)	medium gravel
25-30 (8-9)	medium to coarse sand with medium to coarse gravel
30-35 (9-11)	medium to coarse gravel
35-40 (11-12)	clean fine to coarse gravel
	terminated hole at 42 feet (13 m); hit a boulder

TABLE 7 | SUMMARY OF TEST HOLE DATA, CENTRAL PART OF THE CITY OF TIMMINS

Test Hole Number: TI-TH-5

Location: Murphy Township, Conc. 1, Lot 6

Elevation: Approx. 1000 feet (305 m) a.s.l.

Date: July 30, 1981

Depth feet (metres)	Description
0-5 (0-2)	clean coarse sand and fine gravel
5-10 (2-3)	medium to coarse gravel overlain by silty fine sand
10-15 (3-5)	silty medium to coarse sand and fine gravel
15-20 (5-6)	silty fine to medium sand
20-25 (6-8)	no sample return
25-30 (8-9)	silty fine sand overlain by clean coarse sand

TABLE 7 | SUMMARY OF TEST HOLE DATA, CENTRAL PART OF THE CITY OF TIMMINS

Test Hole Number: TI-TH-6

Location: Tisdale Township, Conc. 5, Lot 7

Elevation: Approx. 1030 feet (315 m) a.s.l.

Date: July 31, 1981

Depth feet (metres)	Description
0-10 (0-3)	medium sand
10-20 (3-6)	fine sand
20-25 (6-8)	silt
25-30 (8-9)	fine sand

Test Hole Number: TI-TH-7

Location: Mountjoy Township, Conc. 1, Lot 11

Elevation: Approx. 1000 feet (305 m) a.s.l.

Date: July 30, 1981

Depth feet (metres)	Description
0-4 (0-1)	clean coarse sand with minor amounts of fine gravel
4-9 (1-3)	medium sand with some silt layers

TABLE 7 | SUMMARY OF TEST HOLE DATA, CENTRAL PART OF THE CITY OF TIMMINS

Test Hole Number: TI-TH-8

Location: Ogden Township, Conc. C, Lot 10 & 11

Elevation: Approx. 1000 feet (305 m) a.s.l.

Date: August 1, 1981

Depth feet (metres)	Description
0-25 (0-8)	clean medium sand
25-30 (8-9)	clean medium sand overlain by silty sand
30-35 (9-11)	silty sand till

Test Hole Number: TI-TH-9

Location: Ogden Township, Conc. B, Lot 10

Elevation: Approx. 975 feet (295 m) a.s.l.

Date: August 1, 1981

Depth feet (metres)	Description
0-5 (0-2)	fine to medium sand
5-10 (2-3)	fine sand
10-15 (3-5)	fine sand with a silt layer
15-20 (5-6)	silty fine sand
20-25 (6-8)	sand silt

TABLE 7 | SUMMARY OF TEST HOLE DATA, CENTRAL PART OF THE CITY OF TIMMINS

Test Hole Number: TI-TH-10

Location: Ogden Township, Conc. A, Lot 10

Elevation: Approx. 1050 feet (320 m) a.s.l.

Date: August 2, 1981

Depth feet (metres)	Description
0-5 (0-2)	medium sand
5-10 (2-3)	medium to coarse sand with minor fine gravel layers
10-15 (3-5)	coarse sand with minor fine gravel layers overlain by fine sand
15-50 (5-15)	fine sand

Test Hole Number: TI-TH-11

Location: Deloro Township, Conc. D, Lot 7

Elevation: Approx. 1050 feet (320 m) a.s.l.

Date: July 30, 1981

Depth feet (metres)	Description
0-10 (0-3)	clean fine to medium sand with a 1-foot (0.3-m) thick fine gravel layer

TABLE 8 | DESCRIBED SECTIONS, CENTRAL PART OF THE CITY OF TIMMINS

Described Section Number: TI-DS-1

Location: Ogden Township, Conc. A, Lot 10

Elevation: Approx. 1020 feet (310 m) a.s.l.

Depth feet (metres)	Description
40 (12)	largely well stratified medium sand with silty fine sand layers and minor amounts of coarse sand and fine gravel

Described Section Number: TI-DS-2

Location: Ogden Township, Conc. A, Lot 10

Elevation: Approx. 1000 feet (305 m) a.s.l.

Depth feet (metres)	Description
0-25 (0-8)	grass covered slope
25-65 (8-20)	well stratified fine to medium sand with occasional coarse sand and fine gravel layers
65-90 (20-27)	well stratified very fine sand

TABLE 8 | DESCRIBED SECTIONS, CENTRAL PART OF THE CITY OF TIMMINS

Described Section Number: TI-DS-3

Location: Price Township, Conc. E, Lot 9

Elevation: Approx. 1000 feet (305 m) a.s.l.

Depth feet (metres)	Description
90 (27)	predominantly slumped medium sand with minor amounts of slumped coarse gravel. However, 15 feet (3 m) above the Grassy River, 2 feet (0.6 m) of medium sand with some fine gravel is exposed

Described Section Number: TI-DS-4

Location: Price Township, Conc. D, Lot 9

Elevation: Approx. 1000 feet (305 m) a.s.l.

Depth feet (metres)	Description
0-12 (0-3)	slumped, medium sand
12-14 (3-4)	medium to coarse gravel
14-26 (4-8)	slumped, medium sand
26-36 (8-11)	medium to coarse gravel
36-100 (11-30)	slumped medium sand

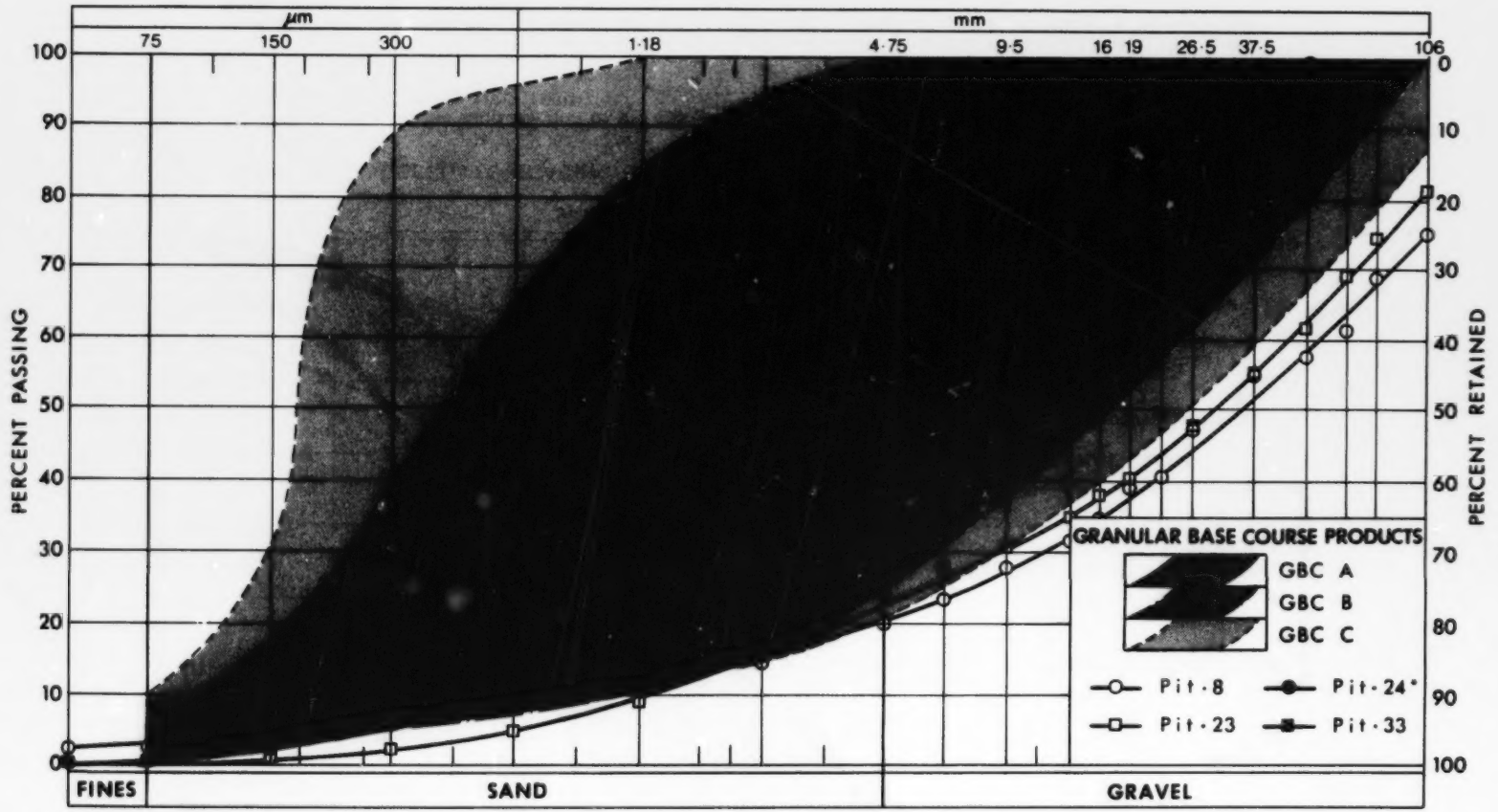


FIGURE 2a: AGGREGATE GRADING CURVES, CENTRAL PART of the CITY of TIMMINS;

Based on analysis of the total aggregate contained in unprocessed samples (gradation envelopes adapted from M.T.C. Form 1010, 1980).

NOTE: Information portrayed by grading curves refers strictly to a specific sample taken at the time of field investigation. Due to the inherent variability of sand and gravel deposits care should be exercised in extrapolating such information to the rest of the deposit.

* The sample from Pit 24 was taken from a sand lense.

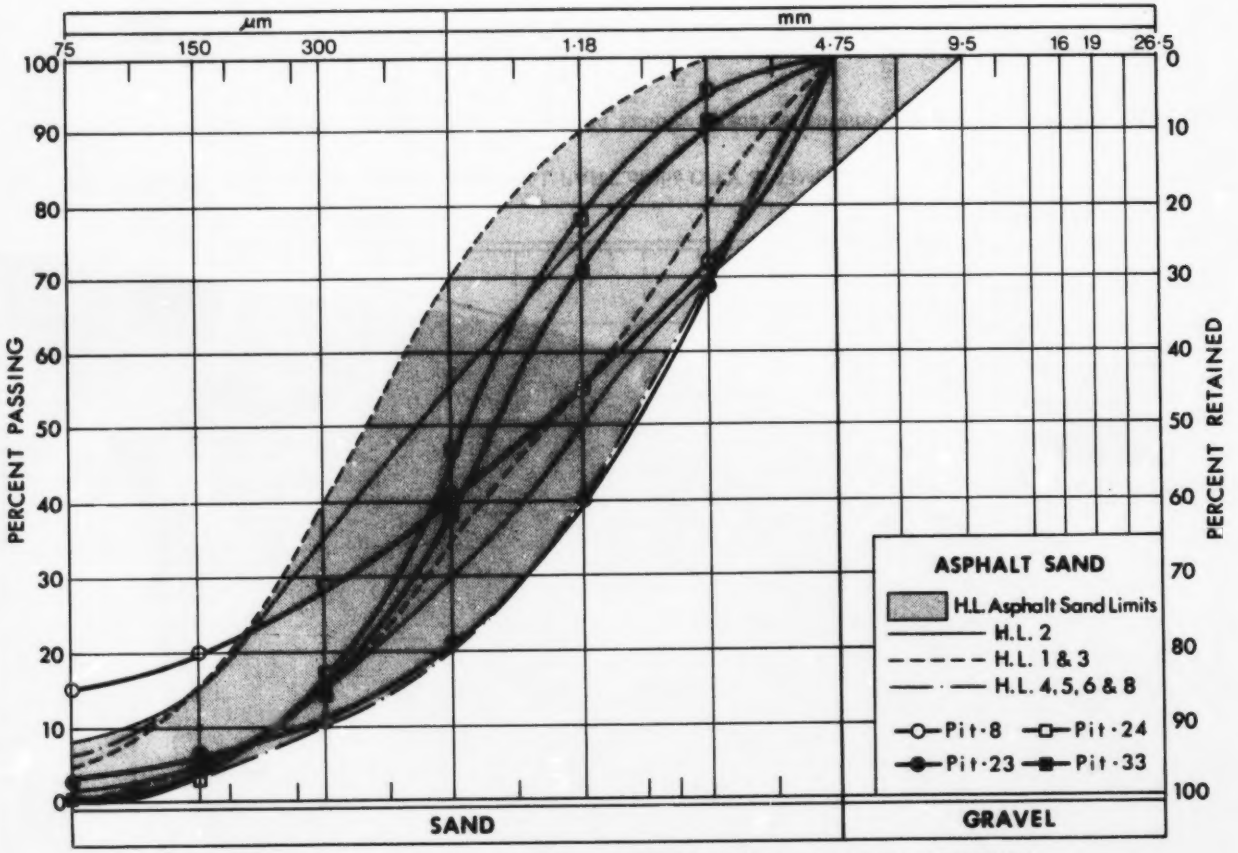


FIGURE 2b: AGGREGATE GRADING CURVES, CENTRAL PART of the CITY of TIMMINS;

Based on analysis of the sand fraction of the aggregate contained in unprocessed samples (gradation envelopes adapted from M.T.C. Form 1003, 1979).

NOTE:

Information portrayed by grading curves refers strictly to a specific sample taken at the time of field investigation. Due to the inherent variability of sand and gravel deposits care should be exercised in extrapolating such information to the rest of the deposit.

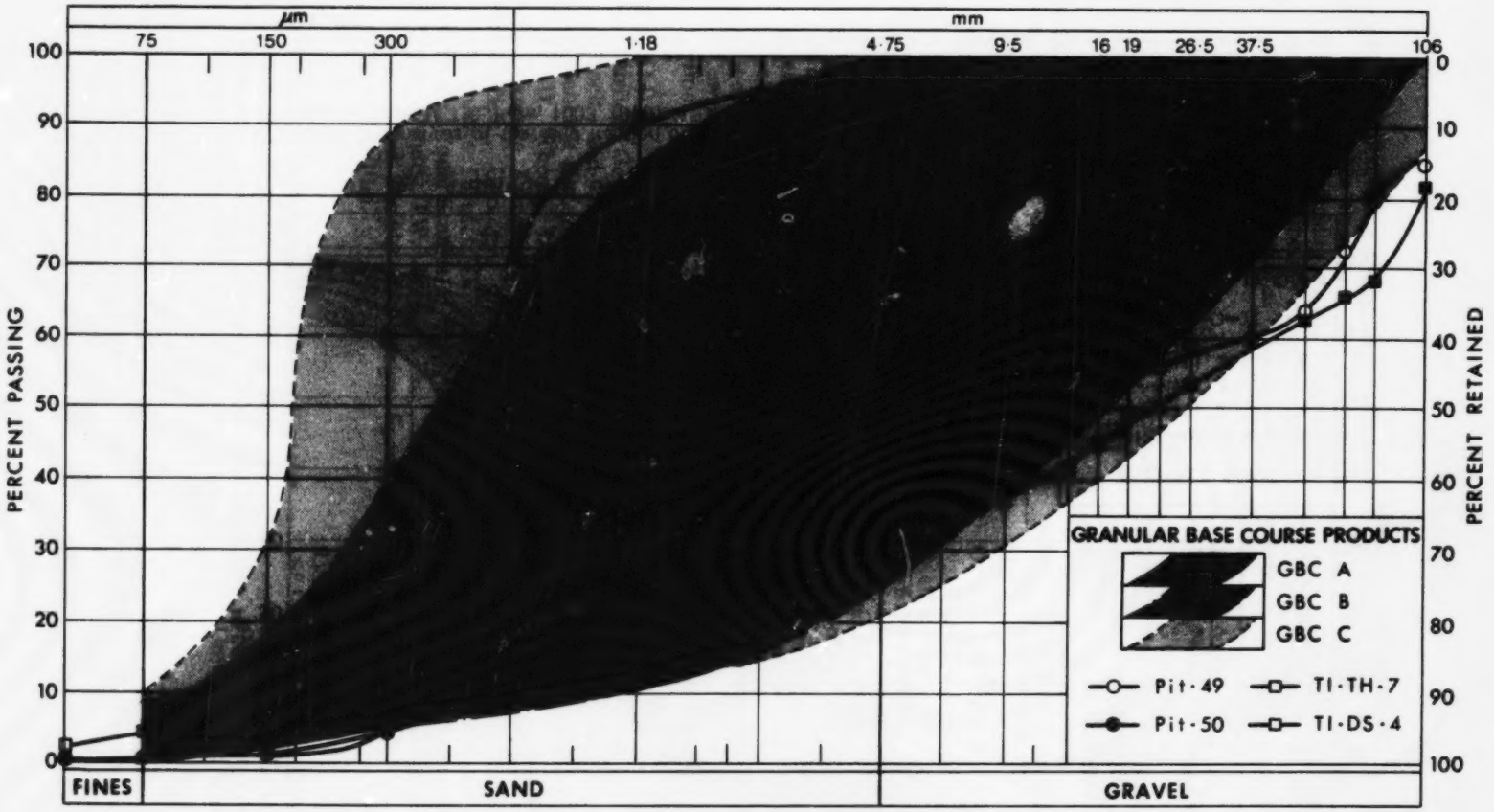


FIGURE 3a: AGGREGATE GRADING CURVES, CENTRAL PART of the CITY of TIMMINS;

Based on analysis of the total aggregate contained in unprocessed samples (gradation envelopes adapted from M.T.C. Form 1010, 1980).

NOTE: Information portrayed by grading curves refers strictly to a specific sample taken at the time of field investigation. Due to the inherent variability of sand and gravel deposits care should be exercised in extrapolating such information to the rest of the deposit.

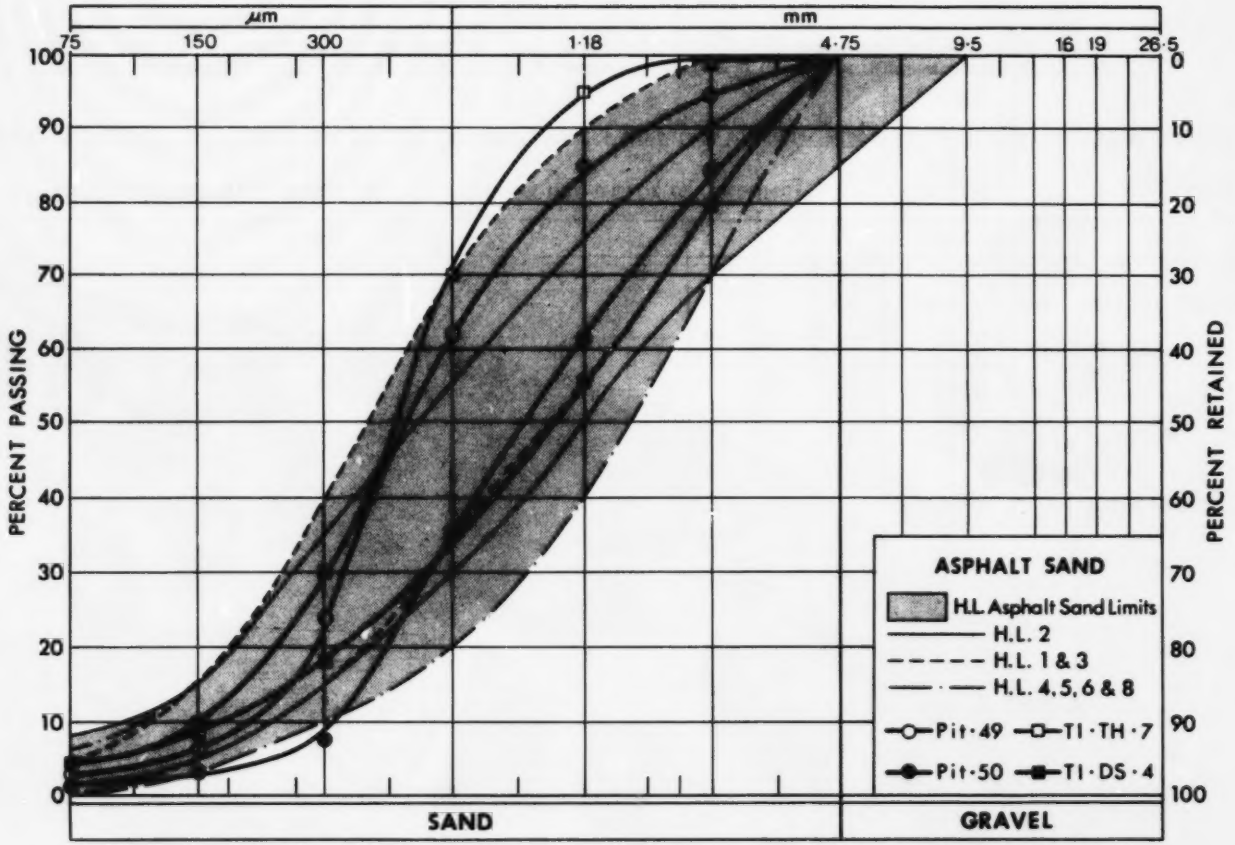


FIGURE 3b: AGGREGATE GRADING CURVES, CENTRAL PART of the CITY of TIMMINS;

Based on analysis of the sand fraction of the aggregate contained in unprocessed samples (gradation envelopes adapted from M.T.C. Form 1003, 1979).

NOTE:

Information portrayed by grading curves refers strictly to a specific sample taken at the time of field investigation. Due to the inherent variability of sand and gravel deposits care should be exercised in extrapolating such information to the rest of the deposit.

REFERENCES

Association of Professional Engineers of Ontario
1976: Performance Standards for Professional Engineers Advising on and Reporting on Oil, Gas and Mineral Properties; Association of Professional Engineers of Ontario, 11 p.

Carlson, H.D.
1967: Geology of Ogden, Deloro and Shaw Townships, District of Cochrane, Ontario; Ontario Department of Mines, Open File Report 5012, 117 p.

Ferguson, S.A.
1959a: Geology of Mountjoy Township, District of Cochrane, Ontario; Ontario Department of Mines, Preliminary Map P. 22, Geological Series, scale 1:15 840.
1959b: Geology of Price Township, District of Timiskaming, Ontario; Ontario Department of Mines, Preliminary Map P. 30, Geological Series, scale 1:15 840.
1964: Geology of Murphy Township, District of Cochrane, Ontario; Ontario Department of Mines, Preliminary Map P. 255, Geological Series, scale 1:15 840.
1968: Geology and Ore Deposits of Tisdale Township; Ontario Department of Mines, Geological Report 58, 177 p.

Hughes, O.L.
1959: Surficial Geology of Part of the Smooth Rock and Iroquois Falls Map-Area, Cochrane District, Ontario; Unpublished Ph.D. Thesis, University of Kansas, Lawrence, Kansas, 190 p.
1965: Surficial Geology of Part of the Cochrane District, Ontario, Canada; in International Studies of the Quaternary, eds. Wright, J.W. Jr. and Frey, D.G., Geological Society of America, Special Paper 84, 30 p.

Hunt, D.S.
1981: Granular Aggregate Resources, Pamour East and West Sheets, City of Timmins; Ontario Geological Survey, Open File Report 5359, 134 p.

Hunt, D.S.; Richard, J.A. and Carey, E.R.
1980: Wark Township, District of Cochrane, Ontario; Ontario Geological Survey, Preliminary Map P. 478 (Revised), Timmins Data Series, scale 1:15 840.

Leahy, E.J.
1971: Geology of the Night Hawk Lake Area, District of Cochrane, Ontario; Ontario Department of Mines and Northern Affairs, Geological Report 96, 74 p.

Lee, H.A.
1979a: Northern Ontario Engineering Geology Terrain Study, Data Base Map, Pamour; Ontario Geological Survey, Map 5026, scale 1:100 000.
1979b: Northern Ontario Engineering Geology Terrain Study, Data Base Map, Timmins; Ontario Geological Survey, Map 5029, scale 1:100 000.

Ontario Interministerial Committee on National Standards and Specifications (Metric Committee)
1975: Metric Practice Guide; 67 p.

Ontario Ministry of Natural Resources
1981: Statistics 1981; Ontario Ministry of Natural Resources, 126 p.

Pyke, D.R.
1974: Timmins Area, Cochrane and Timiskaming Districts, Ontario; Ontario Division of Mines, Preliminary Map P. 941, Geological Series, scale 1:63 360. Geology and compilation 1973.
1980: Geology of the Timmins Area, District of Cochrane; Ontario Geological Survey, Open File Report 5281, 396 p.

Pyke, D.R.; Ayres, L.D. and Innes, D.G.
1973: Timmins-Kirkland Lake Geological Compilation Series, Cochrane, Sudbury and Timiskaming Districts, Ontario; Ontario Division of Mines, Map 2205, scale 1:253 440. Geological compilation 1970-1971.

Richard, J.A.
1981: Quaternary Geology of the Pamour-Kamiskota Lake Area Near Timmins, Ontario; Unpublished B.E.S. Thesis, University of Waterloo, 123 p.

Robertson, J.A.
1975: Mineral Deposit Studies, Mineral Potential Evaluation, and Regional Planning in Ontario; Ontario Division of Mines, Miscellaneous Paper 61, 42 p.

Skinner, R.G.
1972: Drift Prospecting in the Abitibi Clay Belt, Overburden Drilling Program; Geological Survey of Canada, Open File No. 116.
1973: Quaternary Stratigraphy of the Moose River Basin, Ontario; Geological Survey of Canada, Bulletin 225, 77 p.

Tucker, C.M.
in prep: Quaternary Geology of the Timmins Area, Districts of Cochrane and Timiskaming; Ontario Geological Survey, Open File Report in preparation. Geology 1979.

Tucker, C.M. and Sharpe, Diane
1980: Quaternary Geology of the Timmins Area, Districts of Cochrane and Timiskaming; Ontario Geological Survey, Preliminary Map P. 2360, Geological Series, scale 1:50 000. Geology 1979.

APPENDIX A - SUGGESTED ADDITIONAL READING

American Geological Institute
1972: Glossary of Geology; Washington, D.C., 858 p.

Antevs, E.
1928: The Last Glaciation, with Special Reference to the Ice Retreat in Northeastern North America; American Geography Society, Res. Ser. No. 17, 292 p.

Banerjee, I. and McDonald, B.C.
1975: Nature of Esker Sedimentation; in Glaciofluvial and Glaciolacustrine Sedimentation, ed. Jopling, A.V. and McDonald, B.C., Society of Economic Paleontologists and Mineralogists, Special Paper No. 23, 22 p.

Bauer, A.M.
1970: A Guide to Site Development and Rehabilitation of Pits and Quarries; Ontario Department of Mines and Northern Affairs, Industrial Mineral Report 33, 62 p.

Boissonneau, A.N.
1965: Surficial Geology, Algoma-Cochrane; Ontario Department of Lands and Forests, Map S365, scale 1:506 880.
1966: Glacial History of Northeastern Ontario, 1 - The Cochrane-Hearst Area; Canadian Journal of Earth Sciences, Volume 3, Number 5, pp. 559-578.

Chapman, L.J. and Putnam, D.F.
1966: The Physiography of Southern Ontario; Second Edition, Ontario Research Foundation, University of Toronto Press, 386 p.

Coleman, A.P.
1909: Lake Ojibway, Last of the Great Glacial Lakes; Ontario Bureau of Mines, Volume 18, Part 1, 9 p.

Cowan, W.R.
1977: Towards the Inventory of Ontario's Mineral Aggregates; Ontario Geological Survey, Miscellaneous Paper 73, 19 p.

Fairbridge, R.W. (ed.)
1968: The Encyclopedia of Geomorphology; Encyclopedia of Earth Sciences, Vol. III, Reinhold Book Corp., N.Y., 1295 p.

Flint, R.F.
1971: Glacial and Quaternary Geology; John Wiley and Sons Inc., 892 p.

Hewitt, D.F. and Vos, M.A.
1970: Urbanization and Rehabilitation of Pits and Quarries; Ontario Department of Mines, Industrial Mineral Report 34, 21 p.

Hughes, O.L.
1956: Surficial Geology of Smooth Rock, Cochrane District, Ontario; Geological Survey of Canada, Paper 55-41, 9 p.
1961: Preliminary Report on Borings through Pleistocene Deposits, Cochrane District, Ontario; Geological Survey of Canada, Paper 61-16, 5 p.

Ontario
1980: The Mining Act; Revised Statutes of Ontario, 1980, Chapter 268, Queen's Printer for Ontario.

Ontario Mineral Aggregate Working Party
1977: A Policy for Mineral Aggregate Resource Management in Ontario; Ontario Ministry of Natural Resources, 232 p.

Ontario Ministry of Natural Resources
1975: Vegetation for the Rehabilitation of Pits and Quarries; Forest Management Branch, Division of Forests, 38 p.

Terasmae, J. and Hughes, O.L.
1960: A Palynological and Geological Study of Pleistocene Deposits in the James Bay Lowlands, Ontario (42 N½); Geological Survey of Canada, Bulletin 62, 13 p.

Vincent, J.S. and Hardy, L.
1979: The Evolution of Glacial Lakes Barlow and Ojibway, Quebec and Ontario; Geological Survey of Canada, Bulletin 316, 18 p.

APPENDIX B - GLOSSARY

ABRASION RESISTANCE

Tests such as the Los Angeles Abrasion Test are used to measure the ability of aggregate to resist crushing and pulverizing under conditions similar to those encountered in processing and use. Measuring resistance is an important component in the evaluation of the quality and prospective uses of aggregate. Hard, durable material is preferred for road building.

ABSORPTION CAPACITY

Related to the porosity of the rock types of which an aggregate is composed. Porous rocks are subject to disintegration when absorbed liquids freeze and thaw, thus decreasing the strength of the aggregate.

AGGREGATE

Any hard, inert, construction material (sand, gravel, shells, slag, crushed stone or other mineral material) used for mixing in various-sized fragments with a cement or bituminous material to form concrete, mortar, etc., or used alone for road building or other construction. Synonyms include mineral aggregate and granular material.

ALKALI-AGGREGATE REACTION

A chemical reaction between the alkalies of portland cement and certain minerals found in rocks used for aggregate. Alkali-aggregate reactions are undesirable because they can cause expansion and cracking of concrete. Although perfectly suitable for building stone and asphalt applications, alkali-reactive aggregates should be avoided for structural concrete uses.

BLENDING

Required in cases of extreme coarseness, fineness or other irregularities in the gradation of unprocessed aggregate. Blending is done with approved sand-sized aggregate in order to satisfy the gradation requirements of the material.

CLAST

An individual constituent, grain, or fragment of a sediment or rock, produced by the mechanical weathering of a larger rock mass. Synonyms include particle and fragment.

CRUSHABLE AGGREGATE

Unprocessed gravel containing a minimum of 35 percent coarse aggregate larger than the No. 4 sieve (4.75 mm) as well as a minimum of 20 percent greater than the 26.5 mm sieve.

DELETERIOUS LITHOLOGY

A general term used to designate those rock types which are chemically or physically unsuited for use as construction or road-building aggregates. Such lithologies as chert, shale, siltstone, and sandstone may deteriorate rapidly when exposed to traffic and other environmental conditions. Similarly, highly weathered, very porous and friable rock can restrict the quality of the aggregate.

DOLOSTONE

A carbonate sedimentary rock consisting chiefly of the mineral dolomite and containing relatively little calcite (dolostone is also known as dolomite).

DRIFT

A general term for all unconsolidated rock debris transported from one place and deposited in another; distinguished from underlying bedrock. In North America, glacial activity has been the dominant mode of transport and deposition of drift. Synonyms include overburden and surficial deposit.

DRUMLIN

A low, smoothly rounded, elongated hill, mound, or ridge composed of glacial materials. These landforms were deposited beneath an advancing ice sheet, and were shaped by its flow.

EOLIAN

Pertaining to the wind, especially with respect to landforms whose constituents were transported and deposited by wind activity. Sand dunes are an example of an eolian landform.

FINES

A general term used to describe the size fraction of an aggregate which passes (is finer than) the No. 200 mesh screen (0.075 mm). Also described informally as "dirt", these particles are in the silt and clay size range.

GNEISS

A coarse textured metamorphic rock with the minerals arranged in parallel streaks or bands, but lacking schistosity. Gneiss is relatively rich in feldspar. Other common minerals found in this rock include quartz, mica, amphibole and garnet.

GRADATION

The proportion of material of each particle size, or the frequency distribution of the various sizes which constitute a sediment. The strength, durability, permeability and stability of an aggregate depend to a great extent on its gradation. The size limits for different particles are as follows:

Boulders	more than 200 mm
Cobbles	75-200 mm
Coarse Gravel	26.5-75 mm
Fine Gravel	4.75-26.5 mm
Coarse Sand	2-4.75 mm
Medium Sand	0.425-2 mm
Fine Sand	0.075-0.425 mm
Silt, Clay	less than 0.075 mm

GRANITE

Is a coarse-grained light coloured rock that ordinarily has an even texture and is composed of quartz, and feldspar with either mica, hornblende or both.

GRANULAR BASE COURSE

Components of the pavement structure of a road, which are placed on the subgrade and are designed to provide strength, stability, and drainage, as well as support for surfacing materials. Several types have been defined: Granular Base Course A consists of crushed and processed aggregate and has relatively stringent quality standards in comparison to Granular Base Course B and C which are usually pit-run or other unprocessed aggregate.

HOT-LAID (OR ASPHALTIC) AGGREGATE

Bituminous, cemented aggregates used in the construction of pavements either as surface or bearing course (H.L. 1, 3, and 4), or as binder course (H.L. 2, 6, and 8) used to bind the surface course to the underlying granular base course.

LITHOLOGY

The description of rocks on the basis of such characteristics as color, structure, mineralogic composition, and grain size. Generally, the description of the physical character of a rock.

MAGNESIUM SULPHATE SOUNDNESS TEST

This test is designed to simulate the action of freezing and thawing on aggregates. Those aggregates which are susceptible will usually breakdown and give high losses in this test.

MELTWATER CHANNEL

A drainage way, usually terraced, produced by water flowing away from a melting glacier margin.

PETROGRAPHIC EXAMINATION

An aggregate quality test based on known field performance of various rock types. The test result is a Petrographic Number (P.N.). The higher the P.N. the lower the quality of aggregate.

PLEISTOCENE

An Epoch of the recent geological past including the time from approximately 1.8 million years ago to 7000 years ago. Much of the Pleistocene was characterized by extensive glacial activity and is popularly referred to as the "Great Ice Age".

POSSIBLE RESOURCE

Estimates of mineral aggregate material based largely on broad knowledge of the geologic

character of the deposit and for which there are few, if any, samples or measurements. The estimates are based on assumed continuity or repetition for which there are reasonable geological indications.

PRECAMBRIAN

The earliest geologic period extending from the consolidation of the earth's crust to the beginning of the Cambrian.

SHALE

A fine-grained, sedimentary rock formed by the consolidation of clay, silt, or mud and characterized by well developed bedding planes, along which the rock breaks readily into thin layers. The term shale is also commonly used for fissile claystone, silstone, and mudstone.

SOUNDNESS

The ability of the components of an aggregate to withstand the effects of various weathering processes and agents. Unsound lithologies are subject to disintegration caused by the expansion of absorbed solutions. This may seriously impair the performance of road-building and construction aggregates.

TILL

Unsorted and unstratified rock debris, deposited directly by glaciers, and ranging in size from clay to large boulders.

WISCONSINAN

Pertaining to the last glacial stage of the Pleistocene Epoch in North America. It began approximately 100,000 years ago and ended approximately 7000 years ago. The glacial deposits and landforms of Ontario are predominantly the result of glacial activity during the Wisconsinan Stage.

APPENDIX C - GEOLOGY OF SAND AND GRAVEL DEPOSITS

The type, distribution, and extent of sand and gravel deposits in Ontario are the result of extensive glacial and glacially influenced activity in Wisconsinan time during the Pleistocene Epoch, approximately 100,000 to 7000 years ago. The deposit types reflect the different depositional environments that existed during the melting and retreat of the continental ice masses, and they can readily be differentiated on the basis of their morphology, structure, and texture. The deposit types are described below.

GLACIOFLUVIAL DEPOSITS

These deposits can be divided into two broad categories: Those that were formed in contact with (or in close proximity to) glacial ice, and those that were deposited by meltwaters carrying materials beyond the ice margin.

ICE-CONTACT TERRACES (ICT)

These are glaciofluvial features deposited between the glacial margin and a confining topographic high, such as the side of a valley. The structure of the deposits may be similar to that of outwash deposits, but in most cases the sorting and grading of the material is more variable and the bedding is discontinuous due to extensive slumping. The probability of locating large amounts of crushable aggregate is moderate, and extraction may be expensive due to the variability of the deposits both in terms of quality and grain size distribution.

KAMES (K)

Kames are defined as mounds of poorly sorted sand and gravel deposited by meltwater in depressions or fissures on the ice surface or at its margin. During glacial retreat, the melting of supporting ice causes collapse of the deposits, producing internal structures characterized by bedding discontinuities. The deposits consist mainly of irregularly bedded and crossbedded, poorly sorted sand and gravel. The present forms of the deposits include single mounds, linear ridges (crevasse fillings) or complex groups of landforms. The latter are occasionally described as "undifferentiated ice-contact stratified drift" (IC) when detailed subsurface information is unavailable. Since kames commonly contain large amounts of fine-grained material and are characterized by considerable variability, there is generally a low to moderate probability of discovering large amounts of good-quality, crushable aggregate. Extractive problems encountered in these deposits are mainly the excessive variability of the aggregate and the presence of excess fines (silt- and clay-sized particles).

ESKERS (E)

Eskers are narrow, sinuous ridges of sand and gravel deposited by meltwaters flowing in tunnels within or at the base of glaciers, or in channels on the ice surface. Eskers vary greatly in size. Many, though not all eskers consist of a central core of poorly sorted and stratified gravel characterized by a wide range in grain size. The core material is often draped on its flanks by better sorted and stratified sand and gravel. The deposits have a high probability of containing a large proportion of crushable aggregate, and since they are generally built above the surrounding ground surface, are convenient extraction sites. For these reasons esker deposits have been traditional aggregate sources throughout Ontario, and are significant components of the total resources of many areas.

Some planning constraints and opportunities are inherent in the nature of the deposits. Because of their linear nature, the deposits commonly extend across several property boundaries leading to unorganized extractive development at numerous small pits. On the other hand, because of their form, eskers can be easily and inexpensively extracted and are amenable to rehabilitation and sequential land use.

UNDIFFERENTIATED ICE-CONTACT STRATIFIED DRIFT (IC)

This designation may include deposits from several ice-contact, depositional environments which usually form extensive, complex landforms. It is not feasible to identify individual areas of coarse-grained material within such deposits due to their lack of continuity and grain-size variability. They are given a qualitative rating based on existing pit and other subsurface data.

OUTWASH (OW)

Outwash deposits consist of sand and gravel laid down by meltwaters beyond the margin of the glacier. They occur as sheets or as terraced valley fills (valley trains) and may be very large in extent and thickness. Well developed outwash deposits have good horizontal bedding and are uniform in grain size distribution. Outwash deposited near the glacier's margin is much more variable in texture and structure. The probability of locating useful crushable aggregates in outwash deposits is moderate to high depending on how much information on size, distribution and thickness is available.

ALLUVIUM (AL)

Alluvium is a general term for clay, silt, sand, gravel, or similar unconsolidated material deposited during postglacial time by a stream as sorted or semi-sorted sediment, on its bed or on its floodplain. The probability of locating large amounts of crushable aggregate in alluvial deposits is low, and it has generally low value due to the presence of excess silt- and clay-sized material. There are no large postglacial alluvium deposits in Ontario.

GLACIOLACUSTRINE DEPOSITS

GLACIOLACUSTRINE BEACH DEPOSITS (LB)

These are a relatively narrow, linear feature formed by wave action at the shores of glacial lakes that existed at various times during the deglaciation of Ontario. Well developed lacustrine beaches are usually less than 20 feet (6 m) thick. The aggregate is well sorted and stratified and sand-sized material commonly predominates. The composition and size distribution of the deposit depends on the nature of the underlying material. The probability of obtaining crushable aggregate is high when the material is developed from coarse-grained materials such as a stony till, and low when developed from fine-grained materials. Beaches are relatively narrow, linear deposits, so that extractive operations are often numerous and extensive.

GLACIOLACUSTRINE DELTAS (LD)

These features were formed where streams or rivers of glacial meltwater flowed into lakes and deposited their suspended sediment. In Ontario such deposits tend to consist mainly of sand and abundant silt. However, in near-ice and ice-contact positions, coarse material may be present. Although deltaic deposits may be large, the probability of obtaining coarse material is generally low.

GLACIOLACUSTRINE PLAIN (LP)

The nearly level surface marking the floor of an extinct glacial lake. The sediments which form the plain are predominantly fine to medium sand, silt, and clay, and were deposited in relatively deep water. Lacustrine deposits are generally of low value as aggregate sources due to their fine grain size and lack of crushable material. In some aggregate-poor areas, lacustrine deposits may constitute valuable sources of fill and some granular base course aggregate.

GLACIAL DEPOSITS

END MORAINES (EM)

These are belts of glacial drift deposited at, and parallel to, glacier margins. They commonly consist of ice-contact stratified drift and in such instances are usually called kame moraines. Kame moraines commonly result from deposition between two glacial lobes (interlobate moraines). The probability of locating aggregates within such features is moderate to low. Exploration and development costs are high. Moraines may be very large and contain vast aggregate resources, but the location of the best resource areas within the moraine is usually poorly defined.

EOLIAN DEPOSITS

WINDBLOWN FORMS (WD)

Windblown deposits are those formed by the transport and deposition of sand by winds. The form of the deposits ranges from extensive, thin layers to well developed linear and crescentic ridges known as dunes. Most windblown deposits in Ontario are derived from, and deposited on, pre-existing lacustrine sand plain deposits. Windblown sediments are almost invariably composed of fine to coarse sand and are usually well sorted. The probability of locating crushable aggregate in windblown deposits is very low.

APPENDIX D - GEOLOGY OF BEDROCK DEPOSITS
(Modified After Leahy 1971 and Pyke 1980)

METAVOLCANICS (EARLY PRECAMBRIAN)

Rock Type A - Intermediate and Mafic Metavolcanics: consist of mafic metavolcanic flows and metavolcanic fragmental rocks. For the most part, the mafic flows are massive or pillowed. Basalt is the common mafic metavolcanic rock. The volcanic fragmental rocks range from fine-grained tuffs to coarse agglomerates. On fresh surfaces the intermediate and mafic metavolcanics are generally shades of green.

Rock Type B - Felsic Metavolcanics: include rhyolites and rhyodacites along with a variety of felsic pyroclastic rocks. They are usually grey to green on fresh surfaces and weather buff to light grey.

METASEDIMENTS (EARLY PRECAMBRIAN)

Rock Type C: consists dominantly of interlayered greywacke, siltstone and lesser conglomerate. The wackes are usually fine-to medium-grained and are light grey brown on weathered surfaces. Slate and argillite are also present.

METAMORPHOSED MAFIC AND ULTRAMAFIC ROCKS (EARLY PRECAMBRIAN)

Rock Type D - Metamorphosed Ultramafic Rocks: are composed largely of dunites. The dunites consist of densely packed olivine grains and are typically bluish black and rarely light green on fresh surfaces. On weathered surfaces they are light to medium grey or orange brown.

Rock Type E - Metamorphosed Mafic Rocks: consist predominantly of gabbro and diorite. Gabbro is a coarse-grained basic rock. Diorite is also coarse-grained but is intermediate in composition.

FELSIC INTRUSIVE ROCKS (EARLY PRECAMBRIAN)

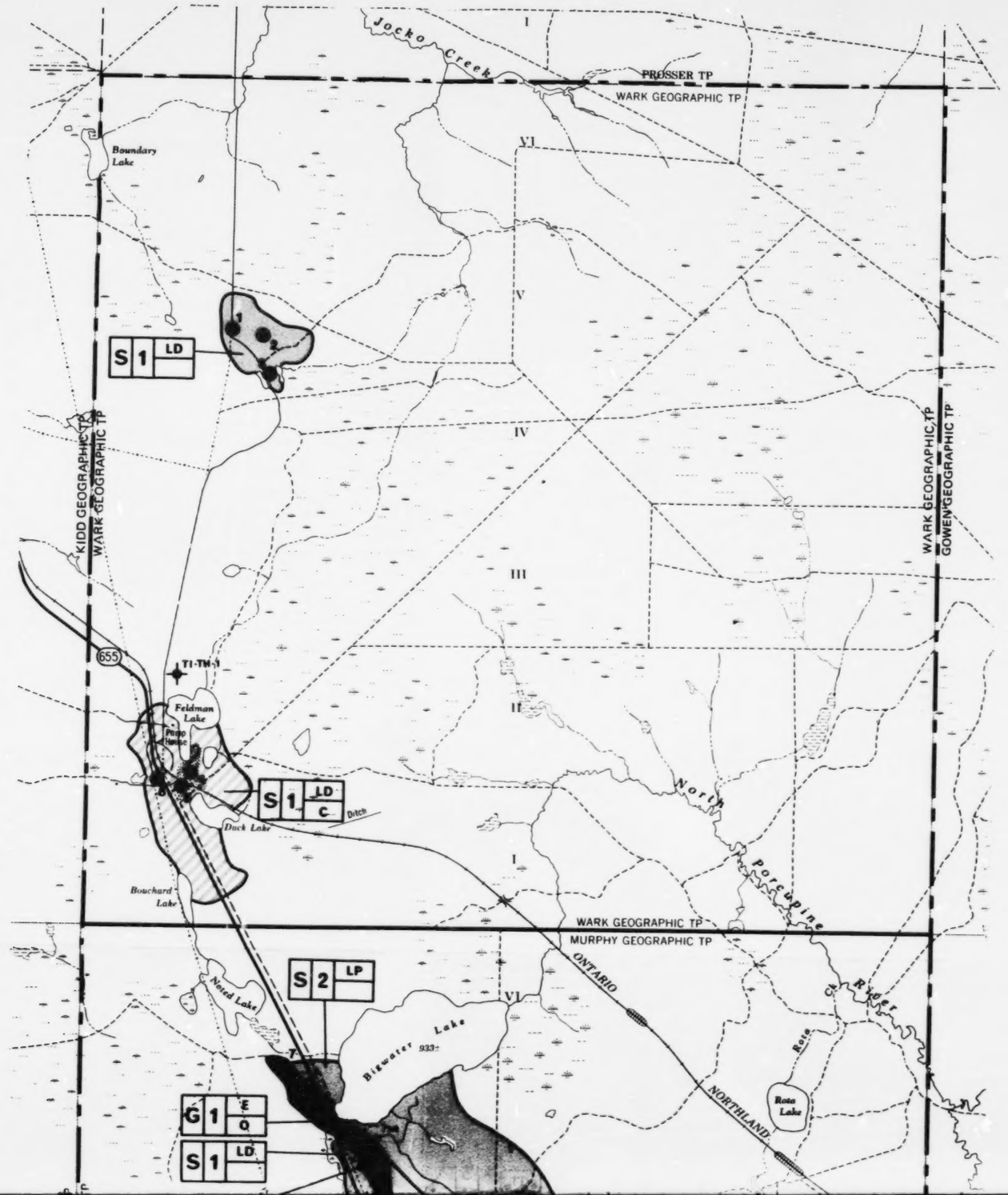
Rock Type F: consists dominantly of granodiorite and to a lesser extent quartz-feldspar porphyries. The granodiorite is usually medium grained and massive to weakly foliated. It is light greyish white to pink on weathered surfaces. The quartz-feldspar porphyries are light grey to buff weathering, moderately to strongly foliated and light green-grey on fresh surfaces.

MAFIC INTRUSIVE ROCKS (EARLY TO LATE PRECAMBRIAN)

Rock Type G: consists largely of quartz-bearing diabase dikes. The diabase is massive and weathers brown to orange brown. Fresh surfaces are dark grey.

Rock Type H: consists mainly of olivine-bearing diabase dikes. The diabase is massive and weathered surfaces are grey to orange brown. The dikes are extremely susceptible to deep weathering.

Jocko Creek
PROSSER TP
WARK GEOGRAPHIC TP
Boundary Lake
S 1 LD
KIDD GEOGRAPHIC TP
WARK GEOGRAPHIC TP
WARK GEOGRAPHIC TP
GOWEN GEOGRAPHIC TP
655
TI-TM-1
Feldman Lake
Pump House
S 1 LD C
Ditch
Duck Lake
Bouchard Lake
North Porcupine River
WARK GEOGRAPHIC TP
MURPHY GEOGRAPHIC TP
S 2 LP
Noted Lake
Bigwater Lake
933
ONTARIO
NORTHLAND
Rota Lake
Rota
G 1 E Q
S 1 LD
I
II
III
IV
V
VI



Ministry of Natural Resources

Ontario

Hon. Alan W. Pope
Minister

W.T. Foster
Deputy Minister

ONTARIO GEOLOGICAL SURVEY

AGGREGATE RESOURCES INVENTORY

CENTRAL PART OF THE CITY OF TIMMINS

COCHRANE DISTRICT

DELORO, MOUNTJOY, MURPHY, OGDEN, PRICE, TISDALE, WARK GEOGRAPHIC TOWNSHIPS

MAP 1
DISTRIBUTION OF SAND AND GRAVEL DEPOSITS

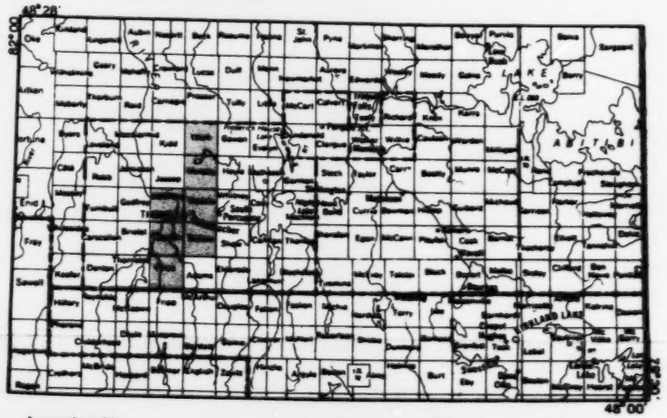
Scale 1: 50 000

Mile 1 0 1 Mile

Metres 1000 0 1 Kilometre

NTS Reference: 42 A/6 42 A/11

© OMNR-OGS 1983



Location Map

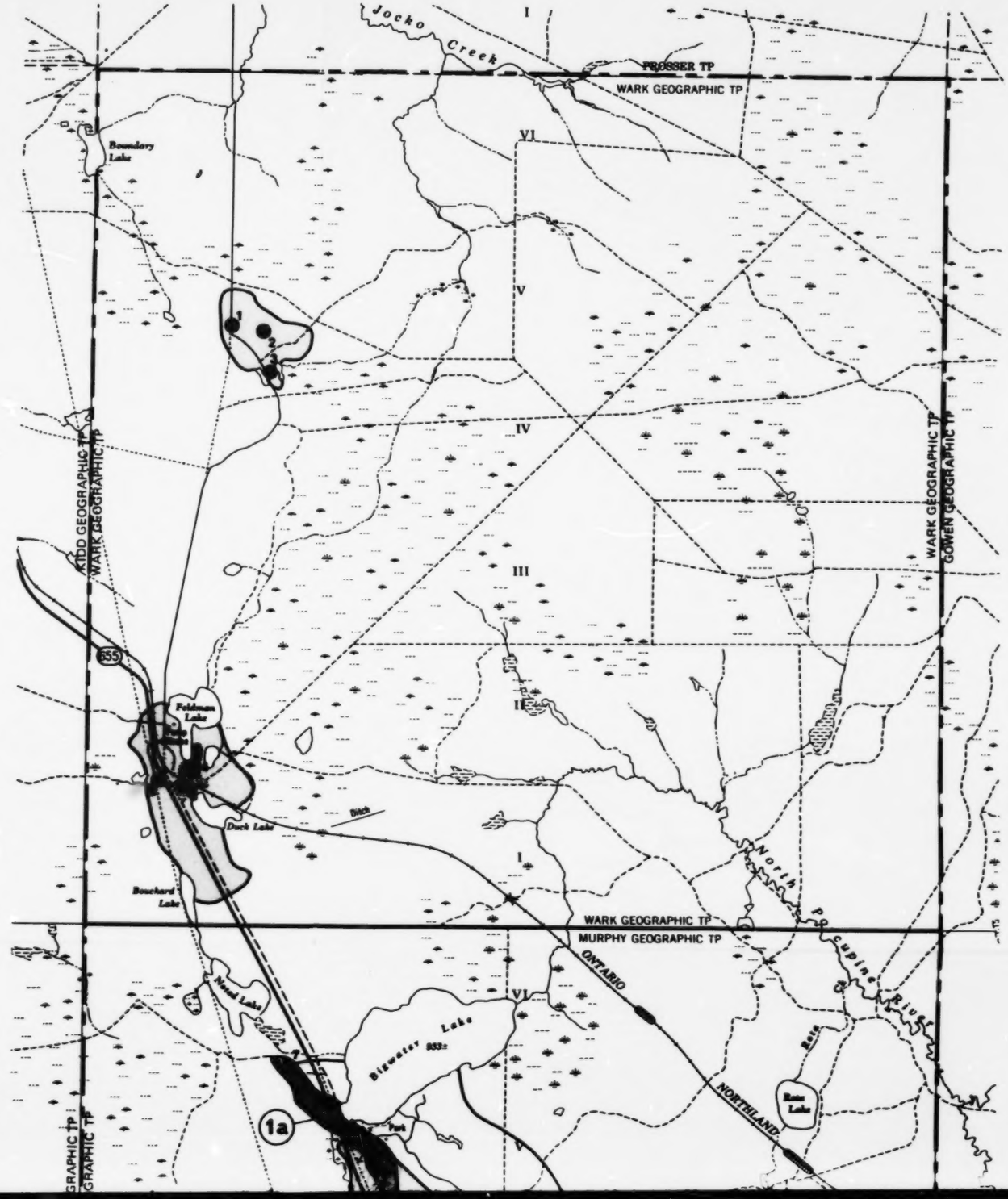
Scale: 1 inch to 25 miles

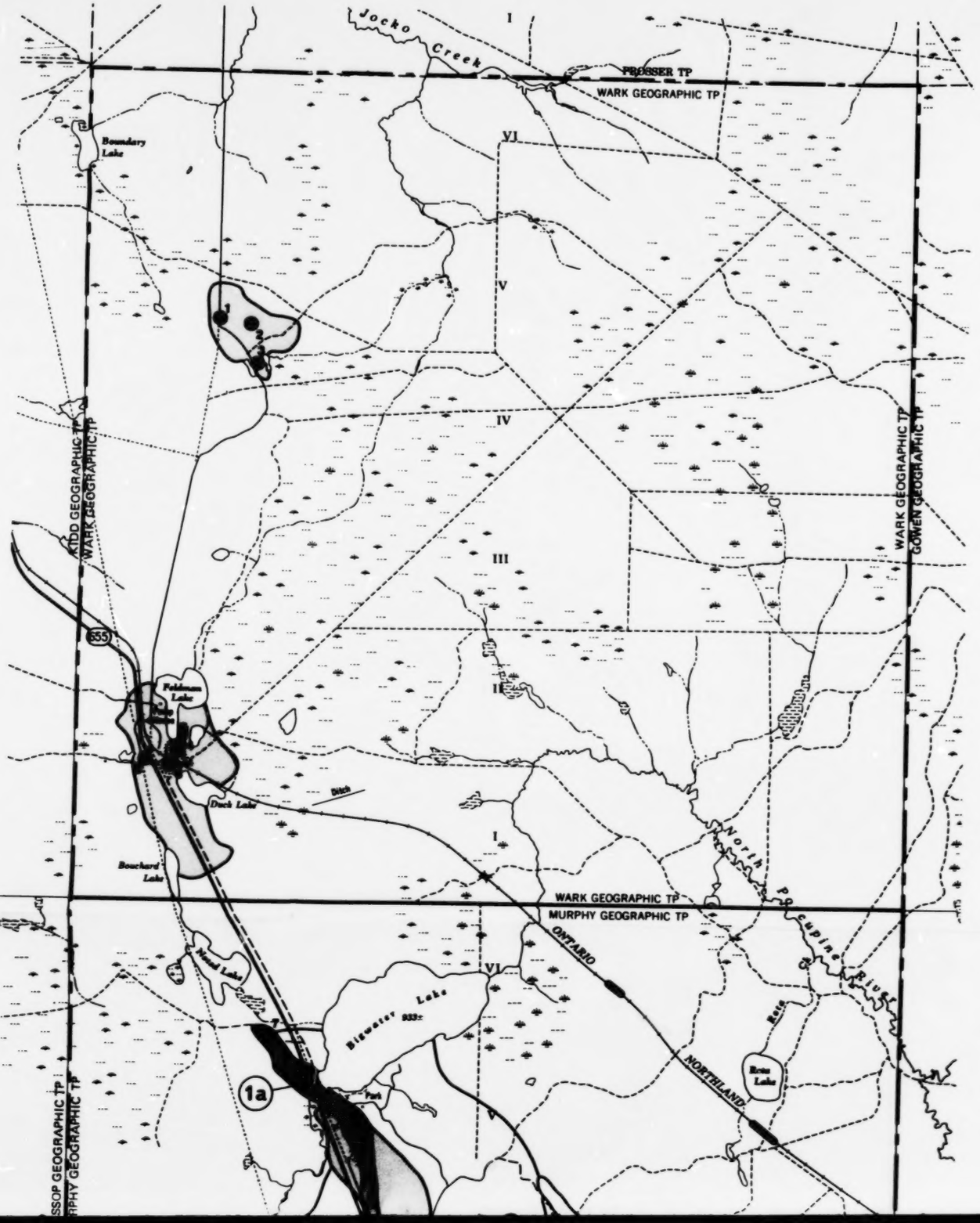
LEGEND

(Some map units and symbols may not apply to this map.)

MAP UNITS

Gravel deposit.


Jocko Creek
I
PROSSER TP
WARK GEOGRAPHIC TP
VI
Boundary Lake
V
IV
III
II
I
655
Pelaheem Lake
Duck Lake
Ditch
Bouchard Lake
WARK GEOGRAPHIC TP
MURPHY GEOGRAPHIC TP
Nesnal Lake
VI
Bisgwaser Lake
833
ONTARIO
NORTHLAND
North Porcupine River
Rapids
Rapids Lake
1a
Park
WARK GEOGRAPHIC TP
GOWEN GEOGRAPHIC TP
KIDD GEOGRAPHIC TP
WARK GEOGRAPHIC TP



Ministry of Natural Resources

Ontario

Hon. Alan W. Pope
Minister

W.T. Foster
Deputy Minister

ONTARIO GEOLOGICAL SURVEY

AGGREGATE RESOURCES INVENTORY

CENTRAL PART OF THE

CITY OF TIMMINS

COCHRANE DISTRICT

DELORO, MOUNTJOY, MURPHY, OGDEN, PRICE, TISDALE, WARK GEOGRAPHIC TOWNSHIPS

MAP 2
SELECTED SAND AND GRAVEL RESOURCE AREAS

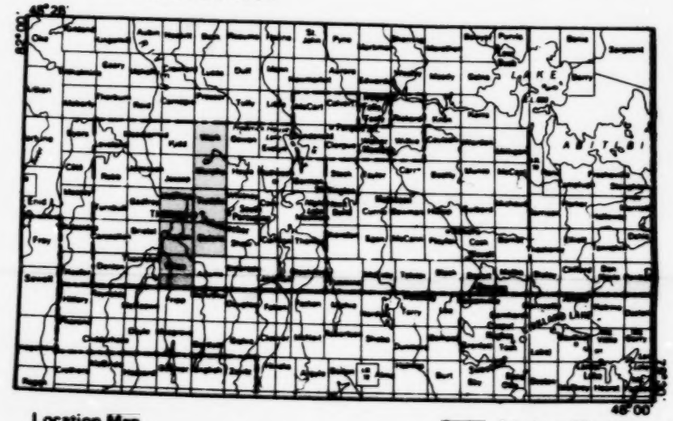
Scale 1: 50 000

Mile 1 0 1 Mile

Metres 1000 0 1 Kilometre

NTS Reference: 42 A/6 42 A/11

© OMNR-OGS 1983



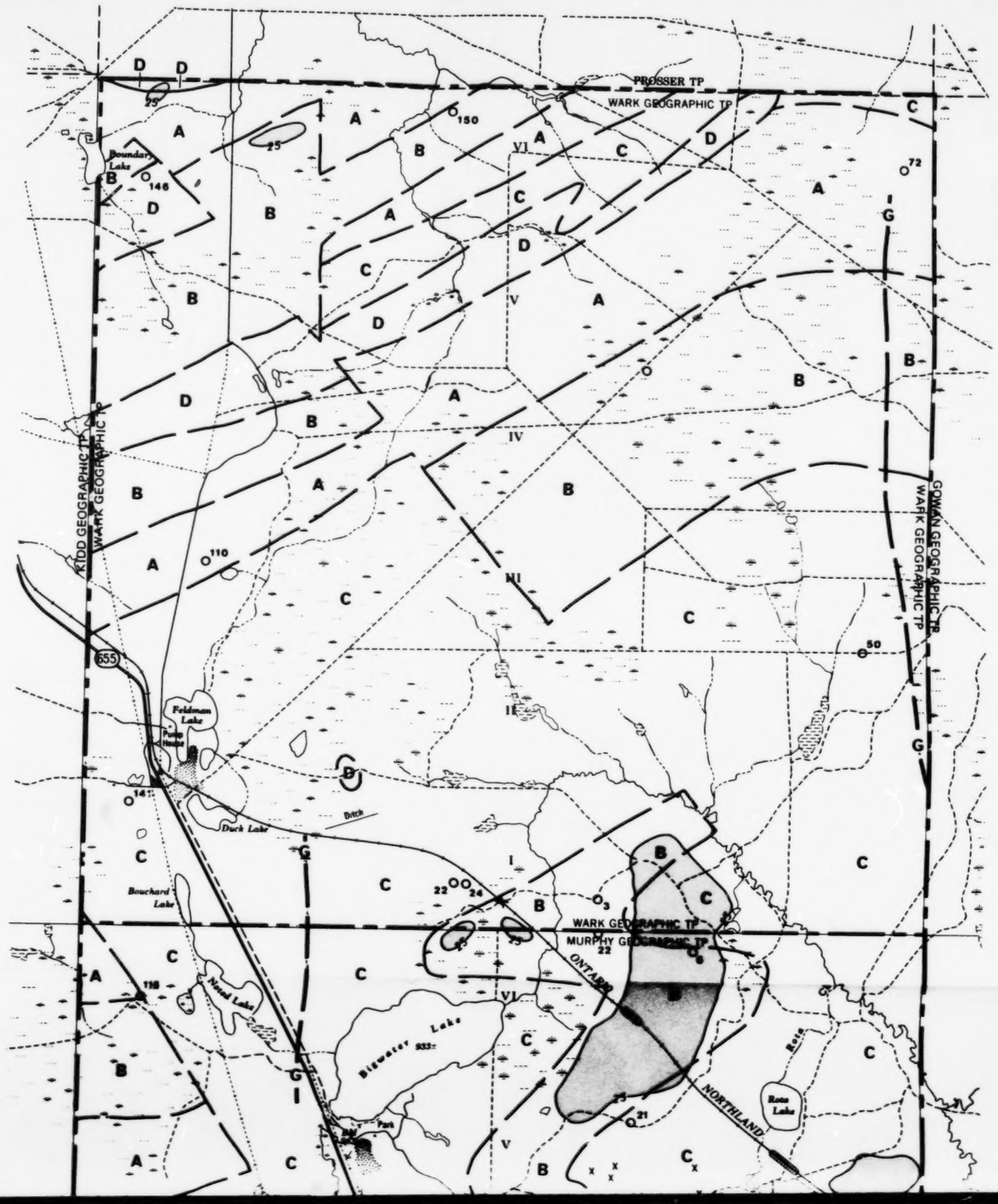
Location Map

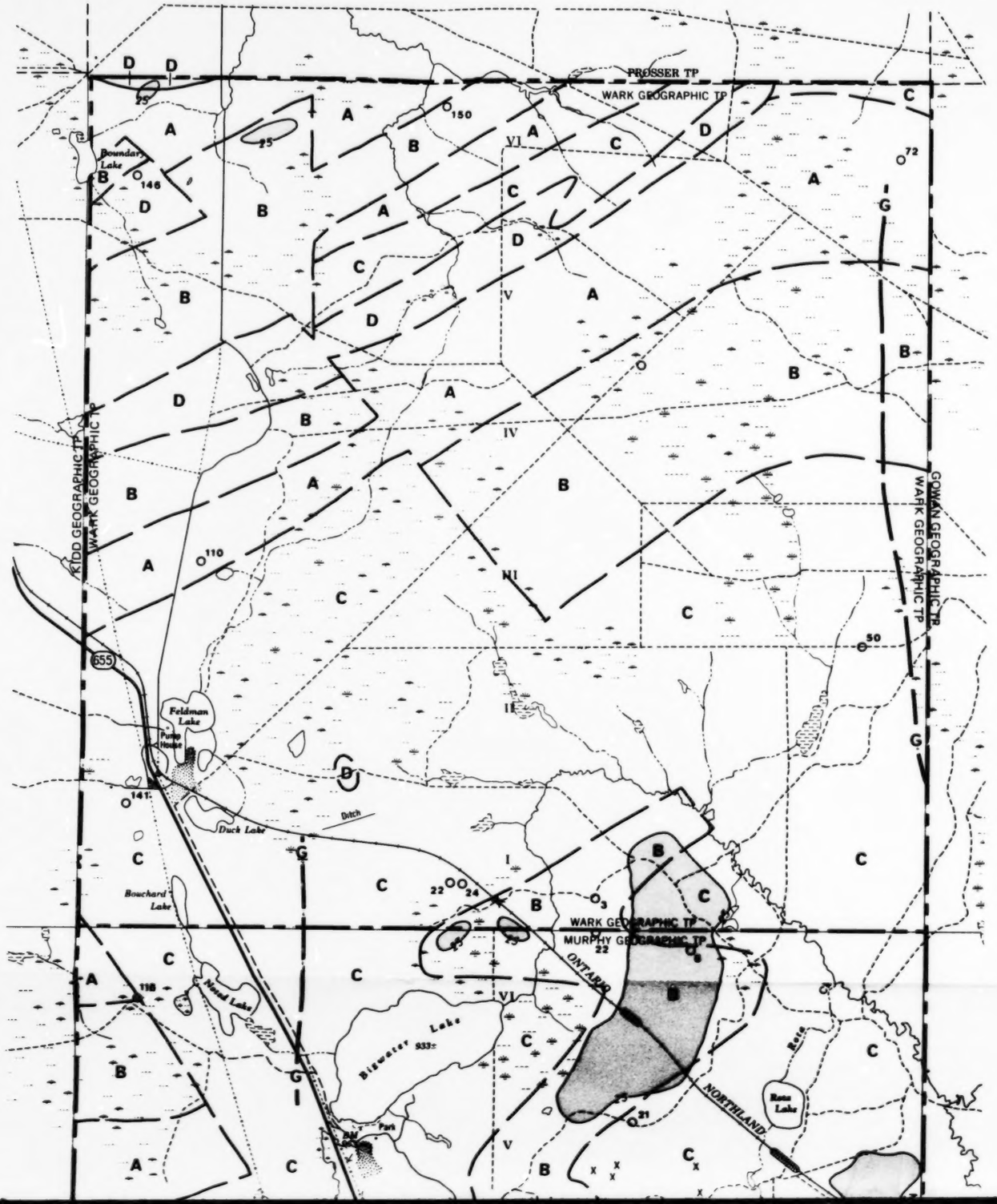
Scale: 1 inch to 25 miles

LEGEND

MAP UNITS

Selected sand and gravel resource area, primary significance; deposit number; see Table 3.


PROSSER TP
WARK GEOGRAPHIC TP
Boundary Lake
Feldmans Lake
Duck Lake
Ditch
Bouchard Lake
Natal Lake
Bleaberry Lake
Park
WARK GEOGRAPHIC TP
MURPHY GEOGRAPHIC TP
ONTARIO
NORTHLAND
Bates Lake
KIDD GEOGRAPHIC TP
WARK GEOGRAPHIC TP
GOWAN GEOGRAPHIC TP
WARK GEOGRAPHIC TP
655



Ministry of Natural Resources

Ontario

Hon. Alan W. Pope
Minister

W.T. Foster
Deputy Minister

ONTARIO GEOLOGICAL SURVEY

AGGREGATE RESOURCES INVENTORY

CENTRAL PART OF THE

CITY OF TIMMINS

COCHRANE DISTRICT

DELORO, MOUNTJOY, MURPHY, OGDEN, PRICE, TISDALE, WARK GEOGRAPHIC TOWNSHIPS

MAP 3
BEDROCK RESOURCES

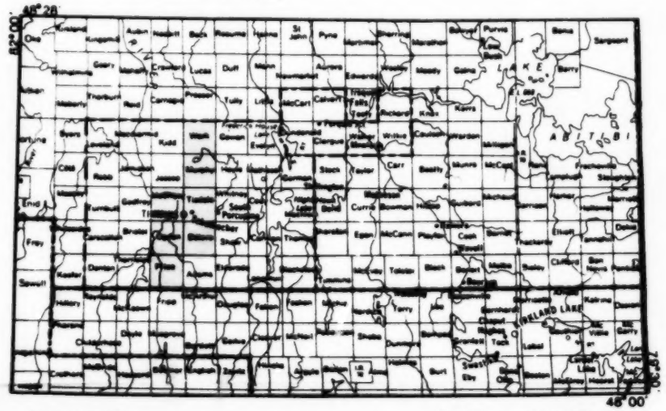
Scale 1: 50 000

Mile 1 0 1 Mile

Metres 1000 0 1 Kilometre

NTS Reference: 42 A/6 42 A/11

© OMNR-OGS 1983



Location Map

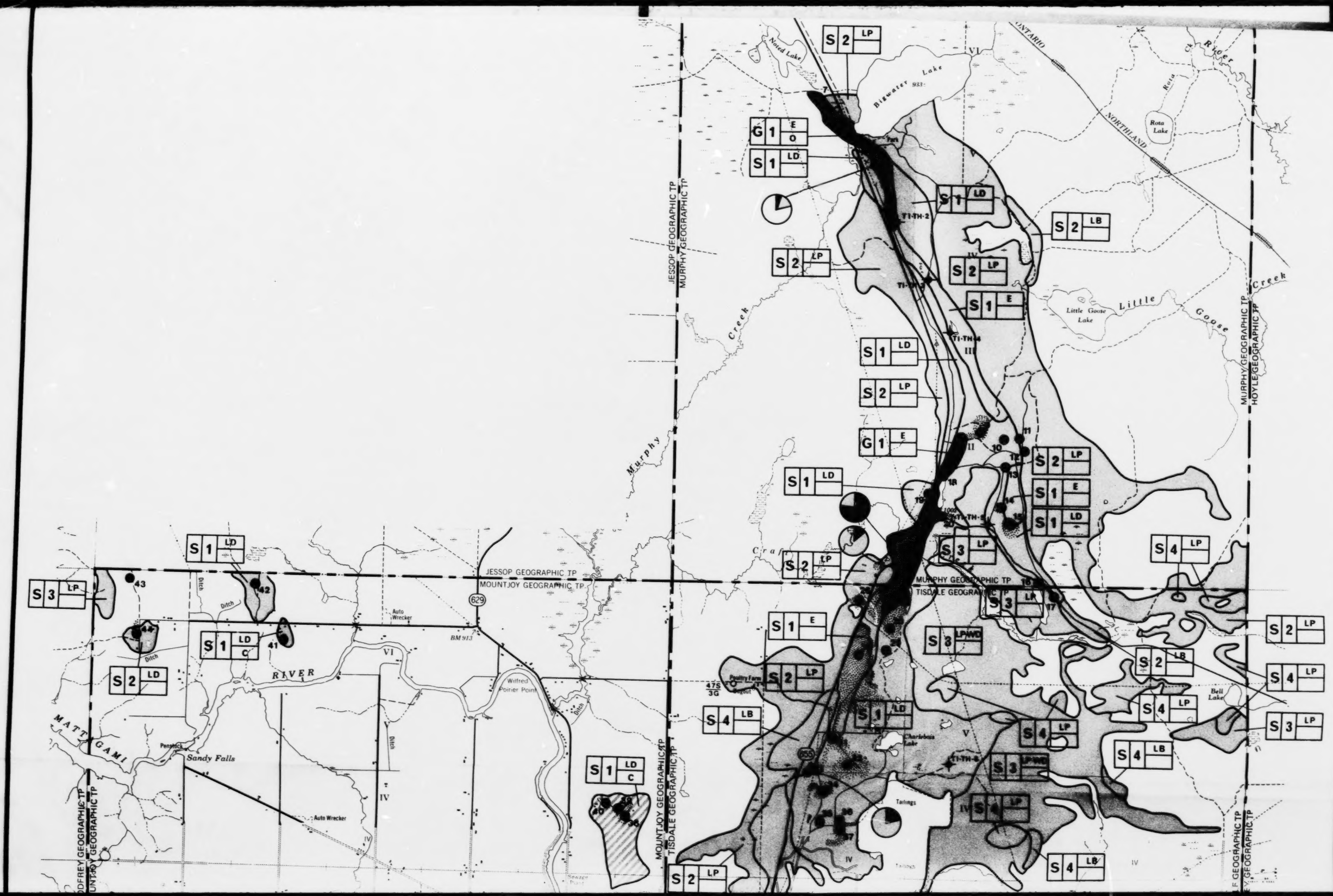
Scale: 1 inch to 25 miles

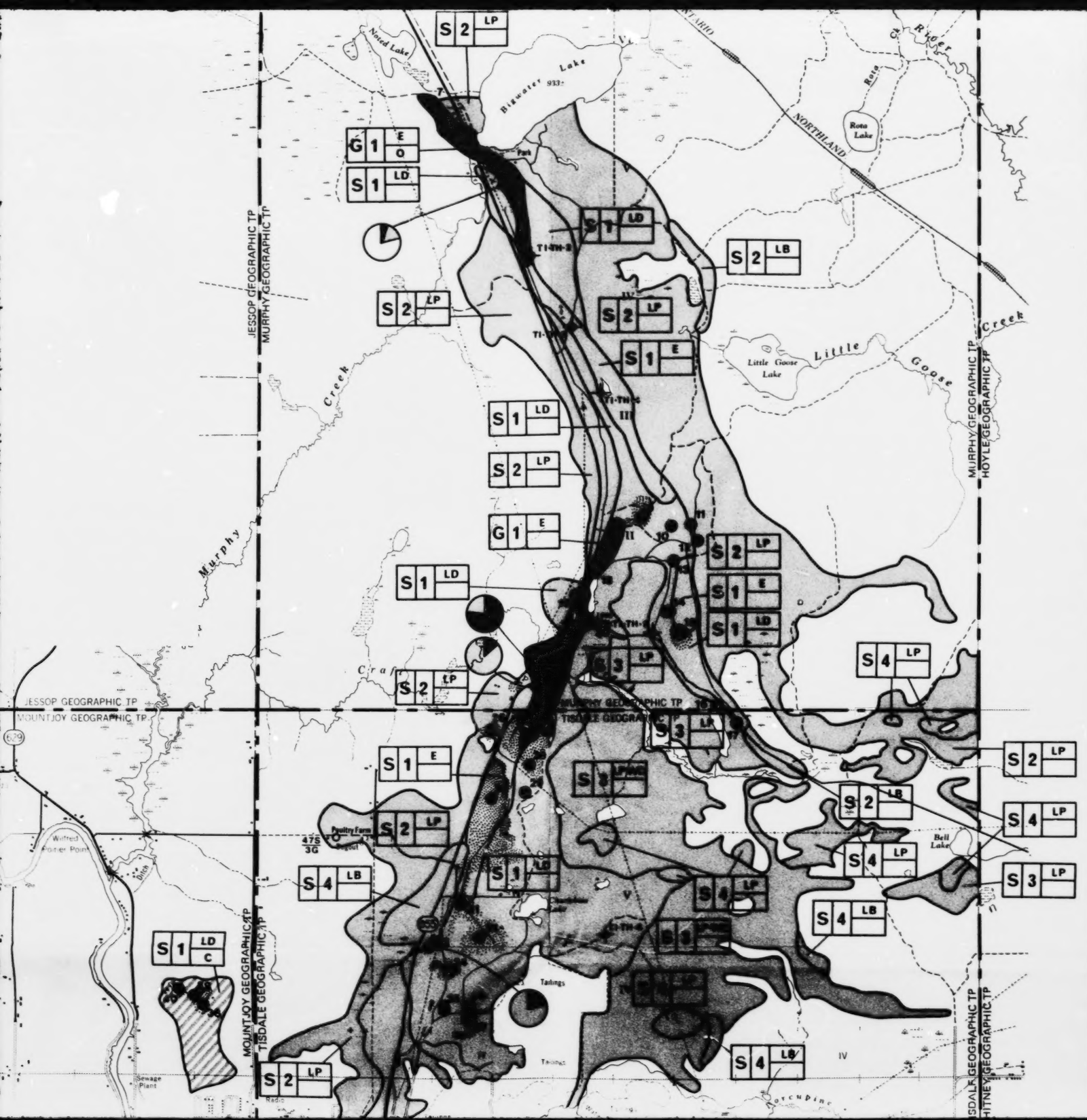
LEGEND

DRIFT THICKNESS

Bedrock outcrop: areas of exposed bedrock partially covered by an irregular veneer of drift. Drift thickness is generally less than 3 feet (1 m); see Table 4.

Bedrock drift complex: areas of bedrock covered by an


S 2 LP
Noted Lake
Bigwater Lake
933
ONTARIO
NORTHLAND
Rota Lake
Rota River
G 1 E O
S 1 LD
JESSOP GEOGRAPHIC TP
MURPHY GEOGRAPHIC TP
T1-TH-2
S 2 LB
S 2 LP
T1-TH-3
S 1 E
Little Goose Lake
Little Goose Creek
T1-TH-4
S 1 LD
S 2 LP
G 1 E
S 1 LD
S 2 LP
S 1 E
S 1 LD
T1-TH-5
S 3 LP
S 4 LP
MURPHY GEOGRAPHIC TP
TISDALE GEOGRAPHIC TP
S 3 LP
S 3 LP/WC
S 1 E
S 2 LP
S 2 LB
S 4 LP
S 4 LB
S 1 LD
Charlebois Lake
Bell Lake
S 3 LP
T1-TH-6
S 4 LP
S 4 LB
Tailings
S 4 LB
S 2 LP
MOUNTJOY GEOGRAPHIC TP
TISDALE GEOGRAPHIC TP
S 1 LD
S 1 LD C
S 3 LP
S 1 LD
S 2 LD
S 1 LD C
Murphy Creek
Ditch
Auto Wrecker
BM 913
Wilfred Poirier Point
RIVER
MATTAGAMI
Penstock
Sandy Falls
Auto Wrecker
Seager Point
GODFREY GEOGRAPHIC TP
MOUNTJOY GEOGRAPHIC TP
MURPHY GEOGRAPHIC TP
HOYLE GEOGRAPHIC TP
629
VI
IV
V
III
II
I



Location Map

Scale: 1 inch to 25 miles

LEGEND

(Some map units and symbols may not apply to this map.)

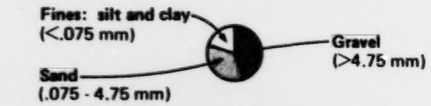
MAP UNITS

- Gravel deposit.
- Sand deposit.
- Gravel overlain by other surficial material.
- Sand overlain by other surficial material.
- Other surficial deposits or exposed bedrock.

SYMBOLS

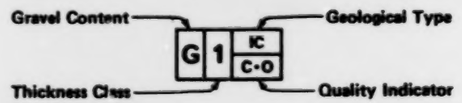
- Geological and aggregate thickness boundary of sand and gravel deposits.
- Municipal, township boundary.
- ● 2 — Sand or gravel pit; identification number; see Table 2.
- Extracted area of sand and gravel pits.
- TI-TH-2 — Test hole location; identification number; see Table 7.
- ▲ TI-DS-2 — Described section; identification number; see Table 8.
- $\frac{6}{23G}$ — Selected water well location. Layers of materials are described by: reported thickness of material (in feet); reported type of material (number only - overburden, G- gravel, S - sand, C - clay, T - till, B - boulders, Bk - bedrock).
- G 1 IC C-O — Deposit symbol; see below.
- Texture symbol; see below; see Figures 2 and 3.

TEXTURE SYMBOL

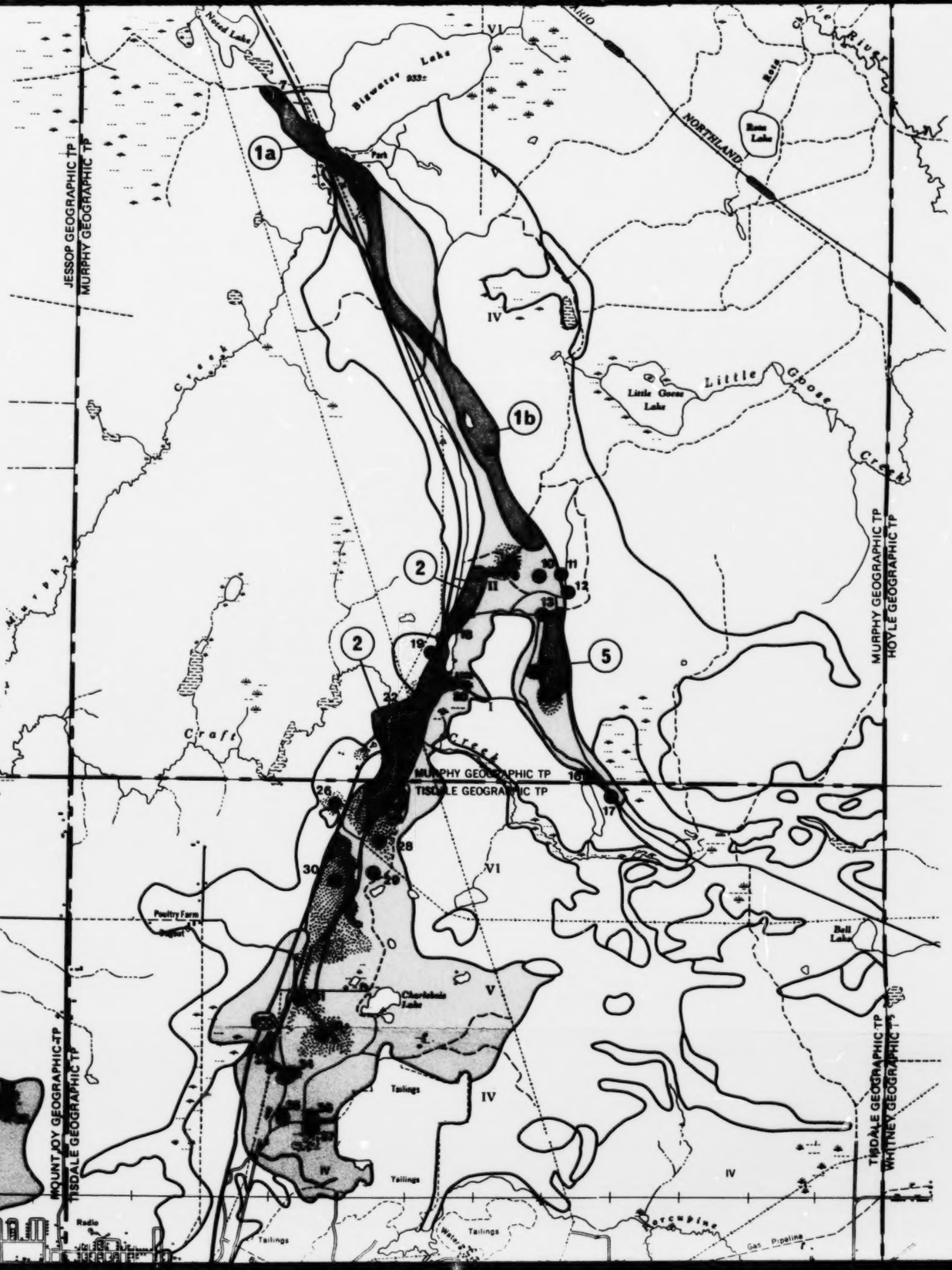


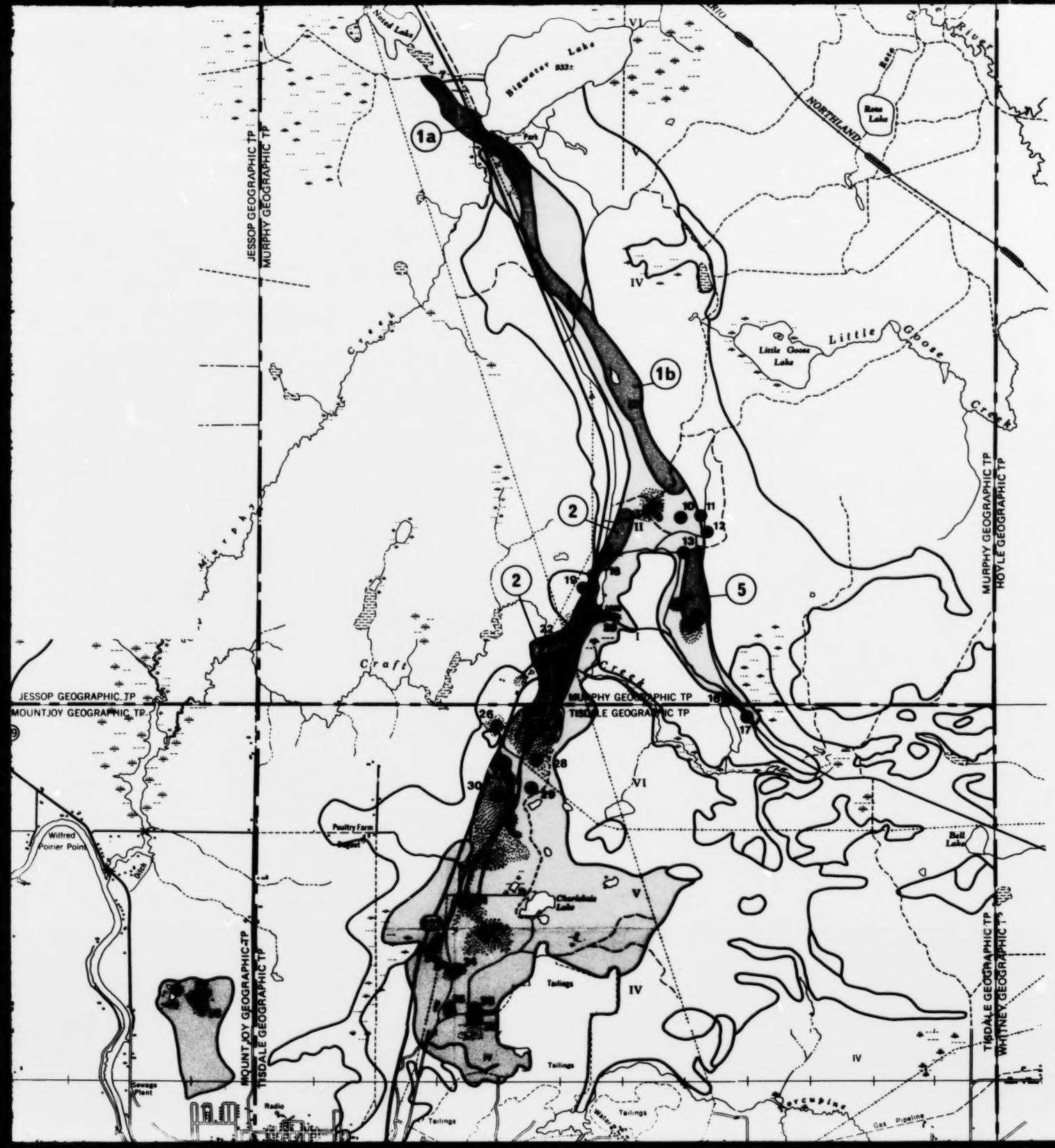
The Texture Symbol provides quantitative assessment of the grain size distribution at a sampled location. The relative amounts of gravel, sand, silt and clay in the sampled material are shown graphically by the subdivision of a circle into proportional segments. The above example shows a hypothetical sample consisting of 45% gravel, 35% sand and 20% silt and clay.

DEPOSIT SYMBOL



Deposits are identified by Gravel Content, Thickness Class, Geological Type and Quality Indicator. Gravel Content is expressed as a percentage of gravel


JESSOP GEOGRAPHIC TP
MURPHY GEOGRAPHIC TP
MOUNTJOY GEOGRAPHIC TP
TISDALE GEOGRAPHIC TP
GODFREY GEOGRAPHIC TP
WHITNEY GEOGRAPHIC TP
HOYLE GEOGRAPHIC TP
NORTHLAND
Nesbitt Lake
Bigwater 933±
Rose Lake
Little Goose Lake
Little Goose Creek
Craft Creek
Sandy Falls
Wilfred Poirier Point
Charbonis Lake
Bell Lake
Poultry Farm
Tailings
Auto Wrecker
Ditch
Radio
Gas Pipeline
Porcupine
1a
1b
2
5
629
BM 913



Location Map

Scale: 1 inch to 25 miles

LEGEND

MAP UNITS

Selected sand and gravel resource area, primary significance; deposit number; see Table 3.

Selected sand and gravel resource area, secondary significance.

Selected sand and gravel resource area, tertiary significance.

SYMBOLS (Some symbols may not apply to this map)

Geological and aggregate thickness boundary of sand and gravel deposits.

Municipal, township boundary.

2 Sand or gravel pit; identification number; see Table 2.

Extracted area of sand and gravel pits.

SOURCES OF INFORMATION

Base map by Surveys and Mapping Branch, Ontario Ministry of Natural Resources.

Aggregate suitability data from the Engineering Materials Office, Ontario Ministry of Transportation and Communications.

Geology by: J. A. Richard, 1981.
C.M. Tucker and Diane Sharpe, 1980.

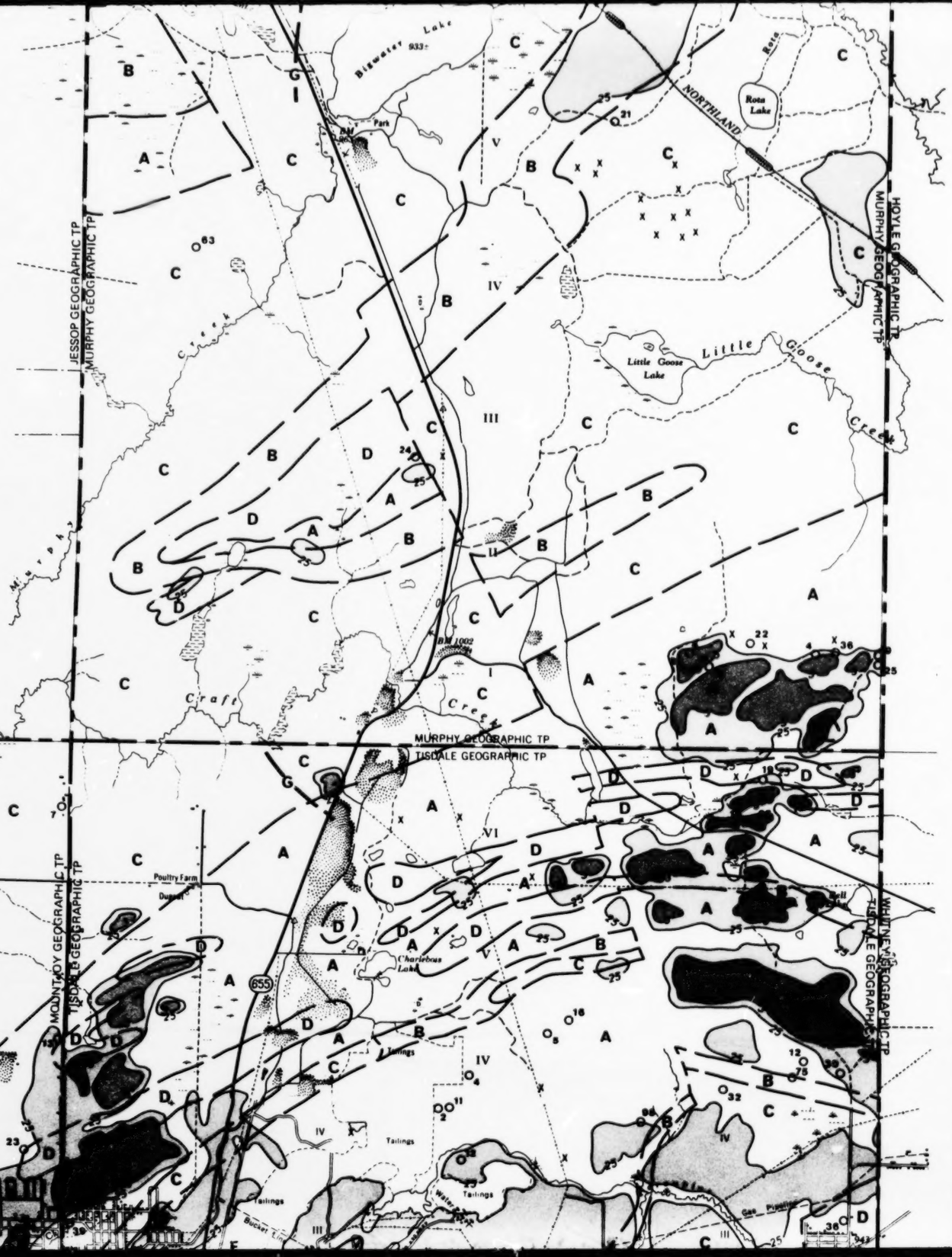
Terrain Evaluation by: H. A. Lee 1979 a,b.

Compilation and Drafting by: Staff of the Aggregate Assessment Office.

This map is to accompany O.G.S. Aggregate Resources Inventory Paper 89.

This map is published with the permission of E. G. Pye, Director, Ontario Geological Survey.
Issued 1983.

JESSOP GEOGRAPHIC TP
MURPHY GEOGRAPHIC TP
MOUNTJOY GEOGRAPHIC TP
TISDALE GEOGRAPHIC TP
HOYLE GEOGRAPHIC TP
WHITNEY GEOGRAPHIC TP
GODFREY GEOGRAPHIC TP
NORTHLAND
Bigwater Lake
Rota Lake
Little Goose Lake
Little Goose Creek
Craft Creek
MATTAGAMI RIVER
Sandy Falls
Wilfred Poirier Point
Charlebois Lake
Poultry Farm
Auto Wrecker
Tailings
Ditch
Park
Cemetery
Homes for Aged
Sewage Plant
Gas Pipeline
BM 913
BM 1002
629
655



Location Map

Scale: 1 inch to 25 miles

LEGEND

DRIFT THICKNESS

Bedrock outcrop: areas of exposed bedrock partially covered by an irregular veneer of drift. Drift thickness is generally less than 3 feet (1 m); see Table 4.

Bedrock drift complex: areas of bedrock covered by an irregular veneer of drift. Drift thickness is generally less than 25 feet (8 m) but may exceed 65 feet (20 m) in bedrock depressions. Isolated bedrock outcrops may occur; see Table 4.

Drift-covered bedrock: areas of bedrock generally covered by more than 25 feet (8 m) of drift. The areas contain isolated outcrops and small areas of thin drift as well as local areas of considerably thicker drift.

BEDROCK UNITS (Some bedrock units may not apply to this map.)

Metavolcanics

- **A** Intermediate and Mafic Metavolcanics
- **B** Felsic Metavolcanics

Metasediments

- **C** Greywacke, Siltstone, Slate, Argillite, and Minor Pebble Conglomerate

Metamorphosed Ultramafic and Mafic Rocks

- **D** Metamorphosed Ultramafic Rocks
- **E** Metamorphosed Mafic Rocks

Felsic Intrusive Rocks

- **F** Granodiorite, Quartz-Feldspar Porphyries

Mafic Intrusive Rocks

- **G** Quartz Diabase Dikes
- **H** Olivine Diabase Dikes

SYMBOLS (Some symbols may not apply to this map)

- (1) Selected bedrock resource area; deposit number; see Table 6.
- Geological boundary.
- 25 Drift thickness contour (3 foot and 25 foot contours are shown).
- Municipal, township boundary.
- Q2 Quarry; identification number; see Table 5.
- x Isolated bedrock outcrop.
- O24 Selected drill hole location; reported depth to bedrock (in feet).

SOURCES OF INFORMATION

Base map by Surveys and Mapping Branch, Ontario Ministry of Natural Resources.

Aggregate suitability data from the Engineering Materials Office, Ontario Ministry of Transportation and Communications.

Selected drill hole data from the Ontario Ministry of the Environment. Geotechnical borehole data from assessment file at the Resident Geologist's Office of the Ministry of Natural Resources, Timmins.

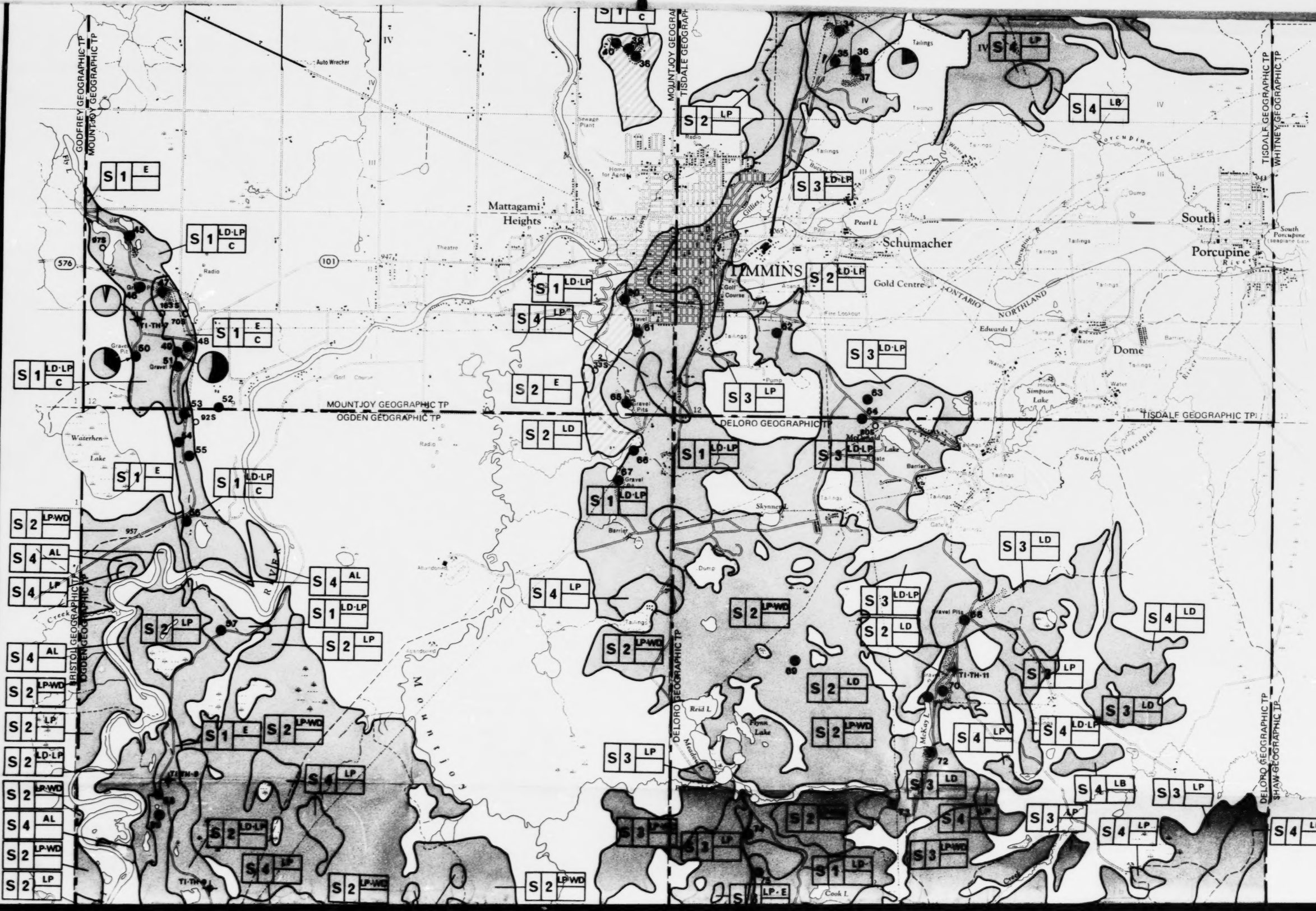
Geology by: H. D. Carlson, 1967. D. R. Pyke, L. D. Ayres, O. G. Innes, 1973. S.A. Ferguson, 1959a, b, 1964, 1968. J. A. Richard, 1981. D. S. Hunt et al., 1980. C. M. Tucker, in prep. D. R. Pyke, 1974, 1980.

Terrain Evaluation by: H.A. Lee, 1979a,b.

Compilation and Drafting by: Staff of the Aggregate Assessment Office.

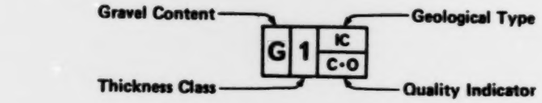
This map is to accompany O.G.S. Aggregate Resources Inventory Paper 89.

This map is published with the permission of E. G. Pye, Director, Ontario


GODFREY GEOGRAPHIC TP
MOUNTJOY GEOGRAPHIC TP
TISDALE GEOGRAPHIC TP
WHITNEY GEOGRAPHIC TP
BRISTOL GEOGRAPHIC TP
OGDEN GEOGRAPHIC TP
DELORO GEOGRAPHIC TP
SHAW GEOGRAPHIC TP
MOUNTJOY GEOGRAPHIC TP
OGDEN GEOGRAPHIC TP
DELORO GEOGRAPHIC TP
TISDALE GEOGRAPHIC TP
Mattagami Heights
TIMMINS
Schumacher
South Porcupine
Porcupine
Gold Centre
Dome
Pearl L.
Edwards L.
Simpson Lake
Skynner L.
Reid L.
Flynn Lake
McKay L.
Cook L.
Waterhen Lake
Mountjoy
Auto Wrecker
Sewage Plant
Home for Aged
Theatre
Golf Course
Fire Lookout
Gravel Pits
Tailings
Barrier
Dump
Pump
Radio
Creek
River
Lake
ONTARIO
NORTHLAND
576
101
TI-TH-8
TI-TH-9
TI-TH-10
TI-TH-11
S 1 E
S 1 LD-LP C
S 1 LD-LP
S 1 E C
S 1 E
S 1 LD-LP C
S 1 LD-LP
S 1 E
S 1 LD-LP
S 1 LD-LP
S 2 LP-WD
S 4 AL
S 4 LP
S 2 LP
S 4 AL
S 1 LD-LP
S 2 LP
S 4 AL
S 2 LP-WD
S 2 LP
S 2 LD-LP
S 2 LP-WD
S 4 AL
S 2 LP-WD
S 2 LP
S 2 LP
S 1 E
S 2 LP-WD
S 4 LP
S 2 LD-LP
S 4 LP
S 2 LP-WD
S 2 LP
S 2 E
S 2 LD
S 4 LP
S 2 LP-WD
S 3 LP
S 1 LD-LP
S 1 LD-LP
S 2 LP-WD
S 2 LD
S 2 LP-WD
S 3 LP
S 3 LD-LP
S 2 LD
S 3 LD
S 4 LD
S 3 LD
S 4 LP
S 4 LD-LP
S 3 LD
S 4 LB
S 3 LP
S 4 LP
S 4 LP
S 4 LP
S 4 LB
S 4 LP
S 3 LP
S 3 LD-LP
S 3 LD-LP
S 3 LD-LP
S 4 LP
S 4 LB
S 4 LP
S 3 LP
S 3 LP
S 3 LP-WD
S 1 LP
S 1 LP-E
S 4 LP
S 4 LP
S 4 LP

sample consisting of 45% gravel, 35% sand and 20% silt and clay.

DEPOSIT SYMBOL



Deposits are identified by Gravel Content, Thickness Class, Geological Type and Quality Indicator. Gravel Content is expressed as a percentage of gravel-sized material (i.e. material retained on the 4.75 mm sieve). Thickness Class is based on potential aggregate tonnage per acre. Geological Type refers to geologic origin. Quality Indicator describes objectionable grain size and lithology.

Gravel Content

G	Greater than 35% gravel.
S	Less than 35% gravel.

Thickness Class

Class	Average Thickness in Feet (Metres)	Tons per Acre	Tonnes per Hectare
1	greater than 20 (>6)	greater than 50,000	greater than 112 000
2	10 - 20 (3 - 6)	25,000 - 50,000	56 000 - 112 000
3	5 - 10 (1.5 - 3)	12,500 - 25,000	28 000 - 56 000
4	less than 5 (<1.5)	less than 12,500	less than 28 000

Geological Type

AL	Older Alluvium	**K**	Kame
E	Esker	**LB**	Lacustrine Beach
EM	End Moraine	**LD**	Lacustrine Delta
IC	Undifferentiated Ice-Contact Stratified Drift	**LP**	Lacustrine Plain
		OW	Outwash
ICT	Ice-Contact Terrace	**WD**	Windblown Forms

(see Appendix C for descriptions of Geological Types)

Quality Indicator

	If blank, no known limitations present.
C	Clay and/or silt (fines) present in objectionable quantities.
L	Deleterious lithologies present.
O	Oversize particles or fragments present in objectionable quantities.

SOURCES OF INFORMATION

Base map by Surveys and Mapping Branch, Ontario Ministry of Natural Resources.

Aggregate suitability data from the Engineering Materials Office, Ontario Ministry of Transportation and Communications.

Selected water well data from the Ontario Ministry of the Environment. Other drilling data from R.G. Skinner, 1972.

Test hole data from Aggregate Assessment Office, Ontario Geological Survey, Ontario Ministry of Natural Resources; Ontario Ministry of Transport and Communications.

Geology by: J. A. Richard, 1981.

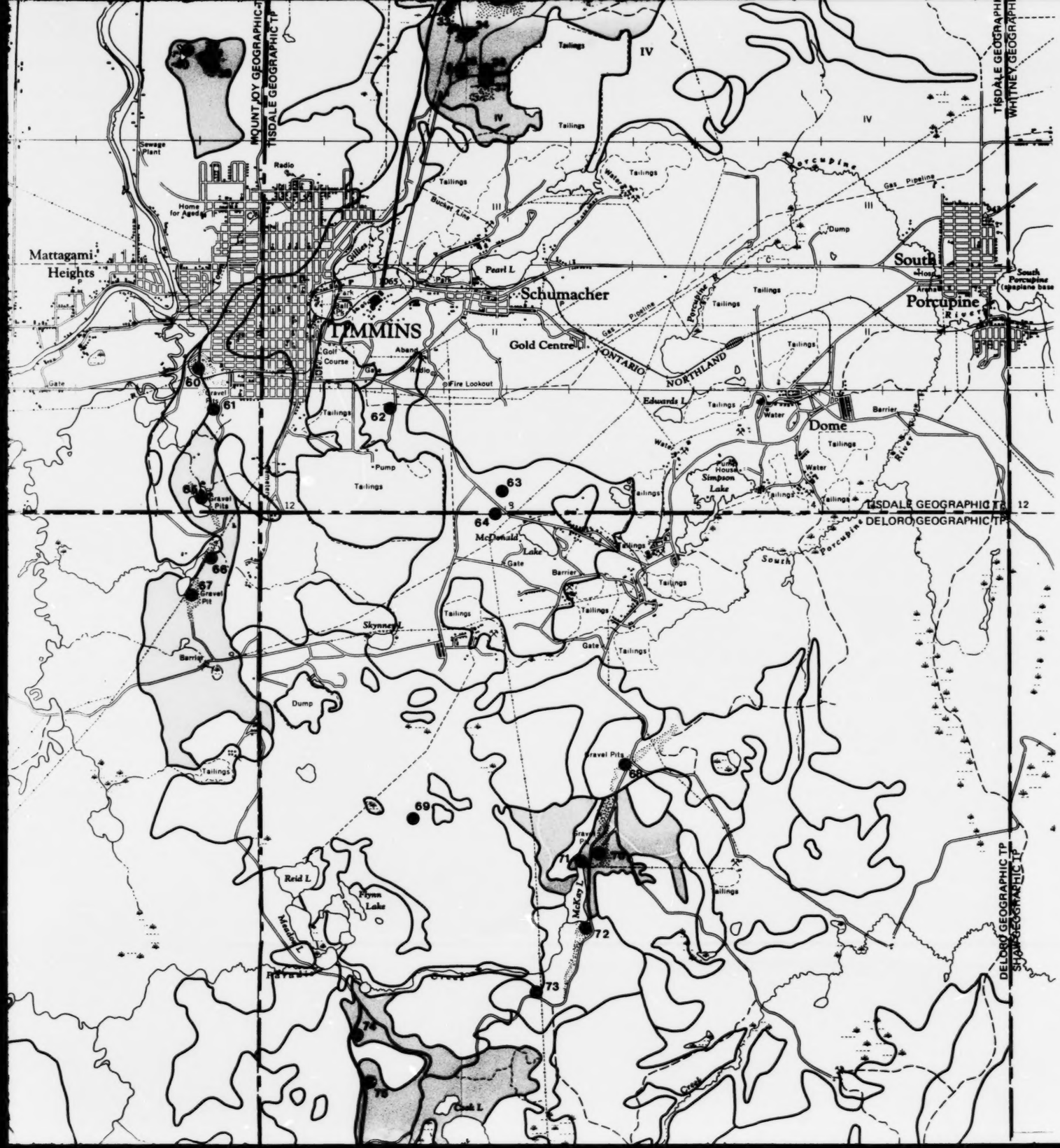
C.M. Tucker and Diane Sharpe, 1980.

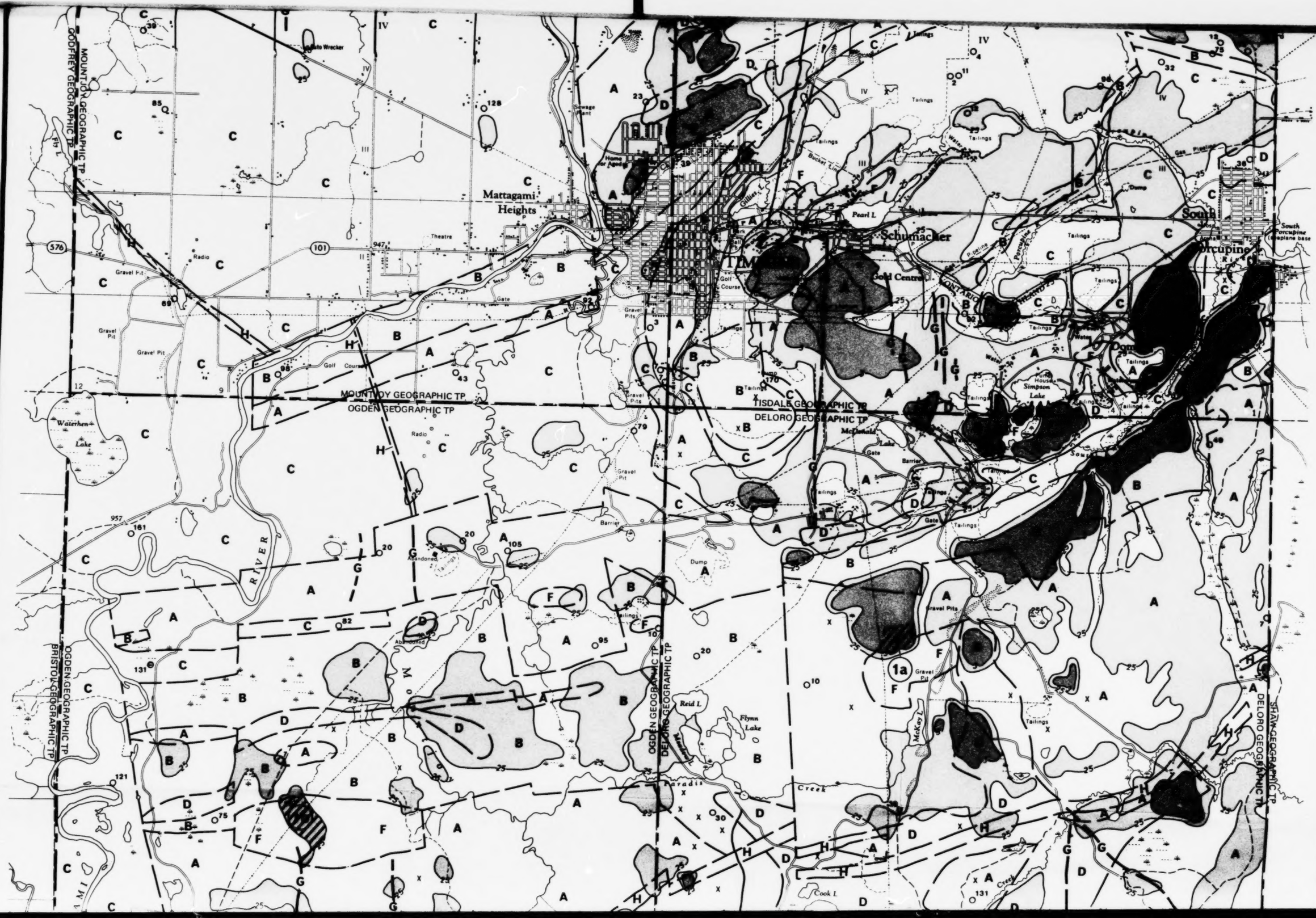
Terrain Evaluation by: H. A. Lee, 1979 a,b.

Compilation and Drafting by: Staff of the Aggregate Assessment Office.

This map is to accompany O.G.S. Aggregate Resources Inventory Paper 89.

GODFREY GEOGRAPHIC TP
MOUNTJOY GEOGRAPHIC TP
MOUNTJOY GEOGRAPHIC TP
TISDALE GEOGRAPHIC TP
TISDALE GEOGRAPHIC TP
WHITNEY GEOGRAPHIC TP
Sandy Falls
Auto Wrecker
Sewage Plant
Radio
Home for Aged
Mattagami Heights
Theatre
Gate
Radio
Golf Course
Gravel Pit
Golf Course
Pump
Tailings
Tailings
Bucke Line
Gillies
Park
Pearl L
Schumacher
Tailings
Tailings
Gas Pipeline
Porcupine R.
Dump
South Porcupine
South Porcupine (aeroplane base
Arena
Porcupine River
TIMMINS
Abandoned
Golf Course
Radio
Fire Lookout
Gold Centre
ONTARIO
NORTHLAND
Edwards L
Tailings
Water
Barrier
Dome
Tailings
Water
Pump House
Simpson Lake
Tailings
Tailings
Water
Tailings
Tailings
Tailings


MOUNT JOY GEOGRAPHIC TP
TISDALE GEOGRAPHIC TP
TISDALE GEOGRAPHIC TP
WHITNEY GEOGRAPHIC TP
Sewage Plant
Radio
Home for Aged
Mattagami Heights
Gillies L
Pearl L
Schumacher
TIMMINS
Golf Course
Abens
Radio
Fire Lookout
Gold Centre
ONTARIO
NORTHLAND
Gas Pipeline
Porcupine R
Porcupine
Gas Pipeline
Bucset Line
Dump
South Porcupine
South Porcupine (spaplane base
Porcupine River
Edwards L
Dome
Barrier
Water
Pump House
Simpson Lake
Pump
Gravel Pits
McDonald Lake
Gate
Barrier
Skynner L
Dump
Tailings
Reid L
Flynn Lake
McKay L
Cook L
TISDALE GEOGRAPHIC TP
DELORO GEOGRAPHIC TP
DELORO GEOGRAPHIC TP
SHOWER GEOGRAPHIC TP
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
I
II
III
IV


GODFREY GEOGRAPHIC TP
MOUNTJOY GEOGRAPHIC TP
Mattagami Heights
Schumacher
South Porcupine
Gold Centre
TIMMINS
Golf Course
Theatre
Radio
Gravel Pit
Gravel Pits
Tailings
Water
Pipeline
Gas Pipeline
Power
Bucket Line
Home for Aged
Sewage Plant
Fly L
Gillies L
Pearl L
Porcupine R
Simpson Lake
McDonald Lake
Barrier Gate
Dump
Abandoned
Reid L
Flynn Lake
McKay L
Paradis Creek
Cook L
Waterhen Lake
MOUNTJOY GEOGRAPHIC TP
OGDEN GEOGRAPHIC TP
TISDALE GEOGRAPHIC TP
DELORO GEOGRAPHIC TP
OGDEN GEOGRAPHIC TP
BRISTOL GEOGRAPHIC TP
DELORO GEOGRAPHIC TP
SHAW GEOGRAPHIC TP
MATTAGAMI RIVER
ONTARIO
576
101
947
957
1a

borehole data from assessment file at the Resident Geologist's Office of the Ministry of Natural Resources, Timmins.

Geology by: H. D. Carlson, 1967.
S.A. Ferguson, 1959a, b, 1964, 1968.
D. S. Hunt et al., 1980.
D. R. Pyke, 1974, 1980.
D. R. Pyke, L. D. Ayres, O. G. Innes, 1973.
J. A. Richard, 1981.
C. M. Tucker, in prep.

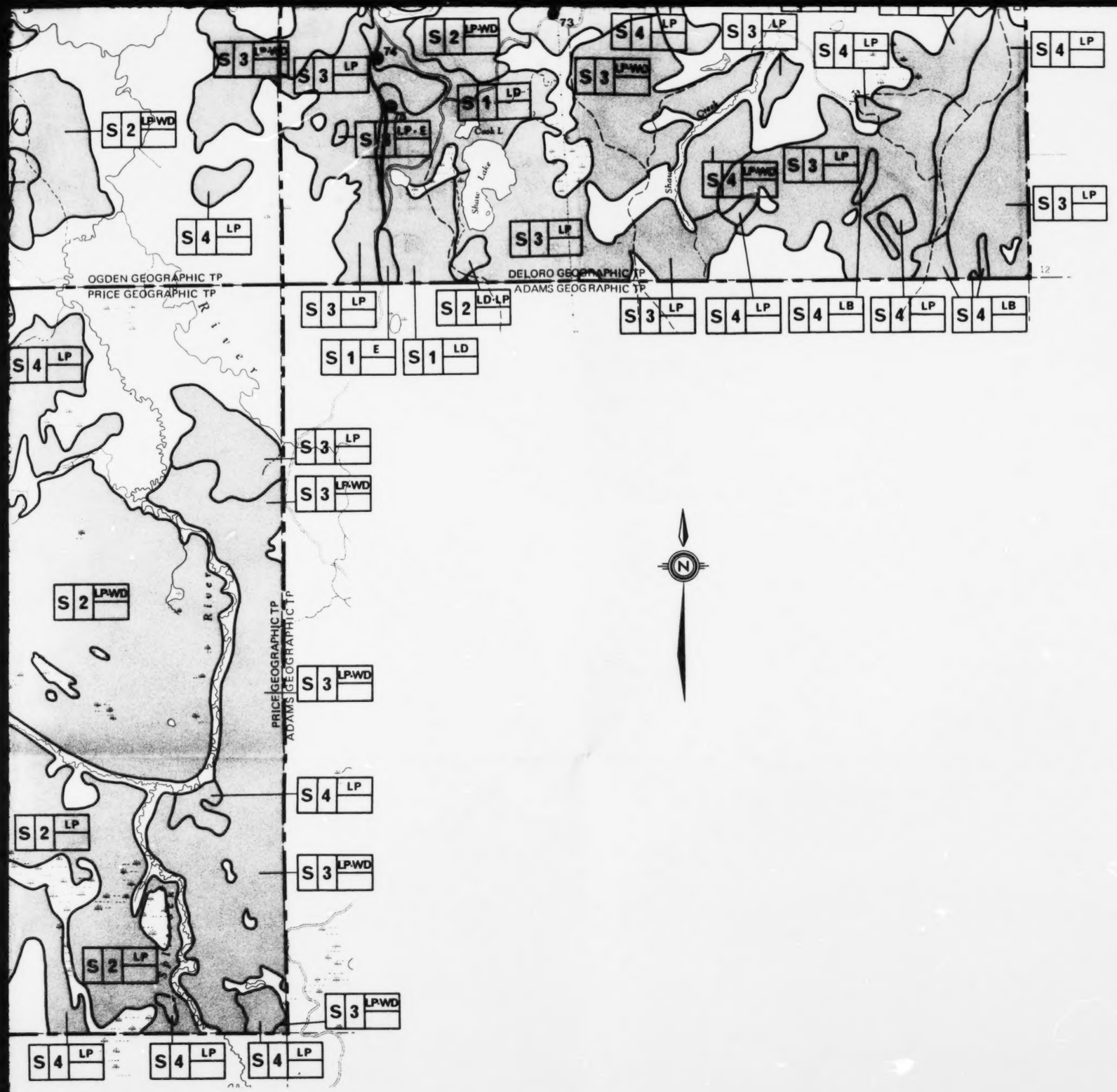
Terrain Evaluation by: H.A. Lee, 1979a,b.

Compilation and Drafting by: Staff of the Aggregate Assessment Office.

This map is to accompany O.G.S. Aggregate Resources Inventory Paper 89.

This map is published with the permission of E. G. Pye, Director, Ontario Geological Survey.
Issued 1983.

OGDEN GEOGRAPHIC TP
PRICE GEOGRAPHIC TP
DELORO GEOGRAPHIC TP
ADAMS GEOGRAPHIC TP
THORNLOE GEOGRAPHIC TP
PRICE GEOGRAPHIC TP
PRICE GEOGRAPHIC TP
ADAMS GEOGRAPHIC TP
COCHRANE DISTRICT
TIMISKAMING DISTRICT
PRICE GEOGRAPHIC TP
FRIPP TP
Driftwood
Cook L.
Shute Lake
Latimer Lake
Alice Lake
Kenabeekogha Lake
Shute Creek
Driftwood Creek
Matagami River
Spring River



Geology by: J. A. Richard, 1981.

C.M. Tucker and Diane Sharpe, 1980.

Terrain Evaluation by: H. A. Lee, 1979 a,b.

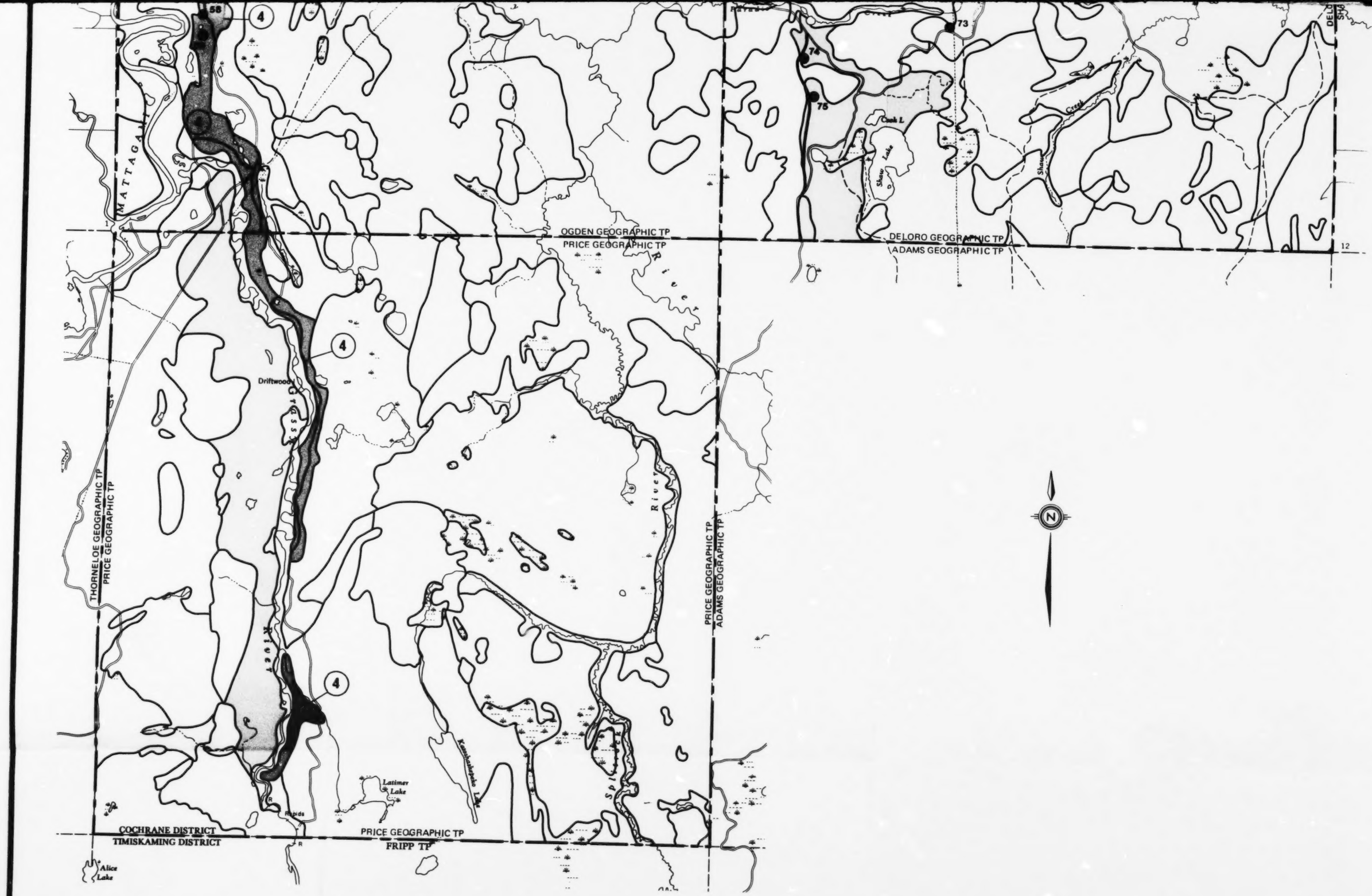
Compilation and Drafting by: Staff of the Aggregate Assessment Office.

This map is to accompany O.G.S. Aggregate Resources Inventory Paper 89.

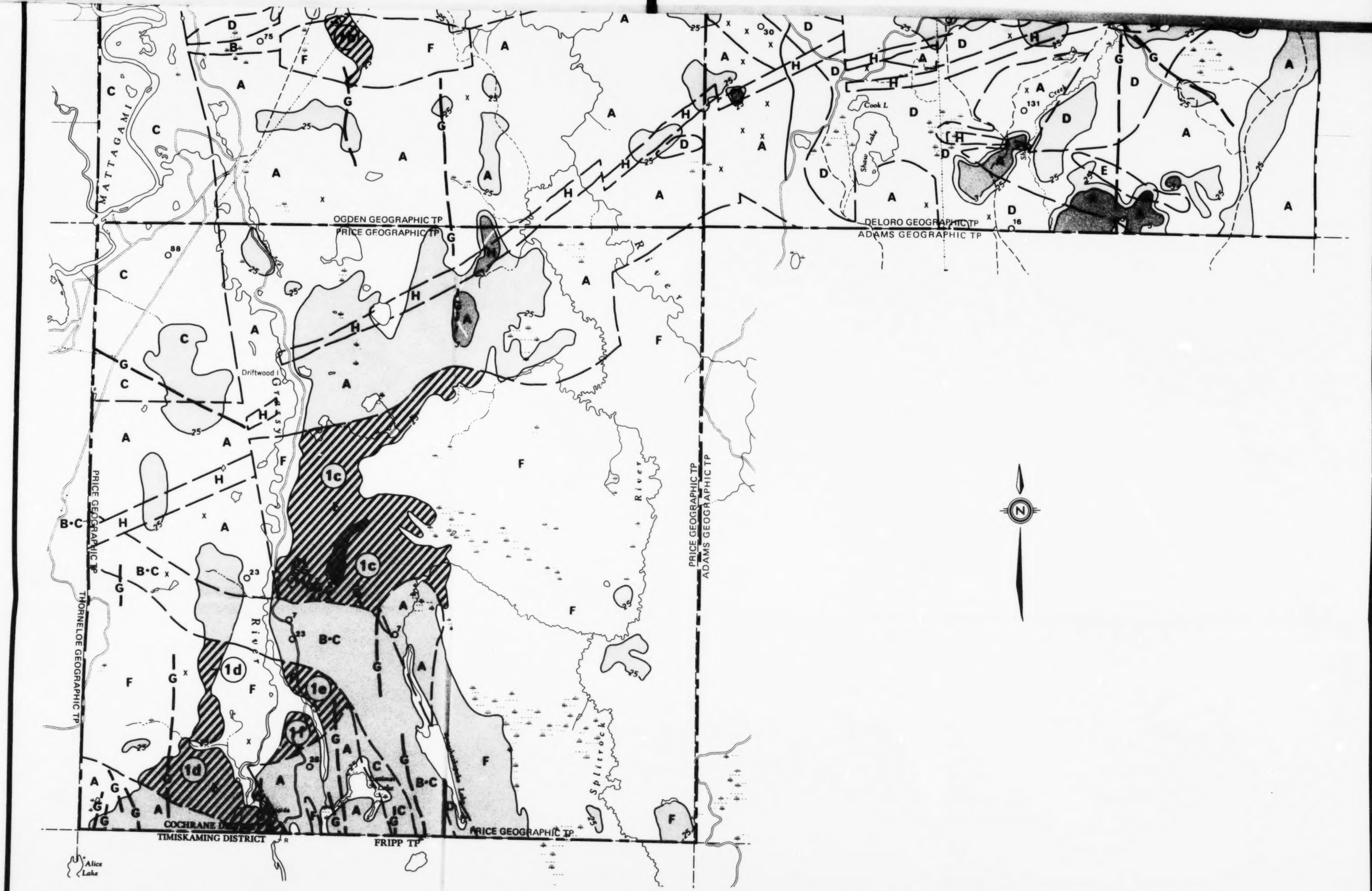
This map is published with the permission of E. G. Pye, Director, Ontario Geological Survey.

Issued 1983.

Information quoted for an individual test hole or pit refers to a specific sample or face. Care should be exercised in extrapolating such information to other parts of the deposit.


58
4
MATTAGAMI
OGDEN GEOGRAPHIC TP
PRICE GEOGRAPHIC TP
73
74
75
Shaw Lake
Shaw Creek
DELORO GEOGRAPHIC TP
ADAMS GEOGRAPHIC TP
12
Driftwood
THORNELOE GEOGRAPHIC TP
PRICE GEOGRAPHIC TP
Latimer Lake
Rapids
COCHRANE DISTRICT
TIMISKAMING DISTRICT
PRICE GEOGRAPHIC TP
FRIPP TP
Alice Lake
PRICE GEOGRAPHIC TP
ADAMS GEOGRAPHIC TP
N

73
76
76
Shaw Lake
Shaw Creek
OGDEN GEOGRAPHIC TP
PRICE GEOGRAPHIC TP
DELORO GEOGRAPHIC TP
ADAMS GEOGRAPHIC TP
12
PRICE GEOGRAPHIC TP
ADAMS GEOGRAPHIC TP
N


MATTAGAMI
OGDEN GEOGRAPHIC TP
PRICE GEOGRAPHIC TP
DELORO GEOGRAPHIC TP
ADAMS GEOGRAPHIC TP
Cook L
Shaw Lake
Creek
Driftwood I
Driftwood River
PRICE GEOGRAPHIC TP
THORNELOE GEOGRAPHIC TP
River
1c
1d
1e
1f
Splitrock
PRICE GEOGRAPHIC TP
ADAMS GEOGRAPHIC TP
COCHRANE DISTRICT
TIMISKAMING DISTRICT
FRIPP TP
PRICE GEOGRAPHIC TP
Alice Lake
N

DELORO GEOGRAPHIC TP

ADAMS GEOGRAPHIC TP

PRICE GEOGRAPHIC TP

PRICE GEOGRAPHIC TP

Cook L.

Shaw Lake

Creek

River

Splitrock

N

POOR

QUALITY

ORIGINAL